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Conference on Medical Screening and Biological Monitoring for the Effects of Exposure in the Workplace, Held at Cincinnati, Ohio on July 10-13, 1984

(U.S.) National Inst. for Occupational Safety and Health, Cincinnati, OH

Prepared for

National Cancer Inst., Bethesda, MD

1984

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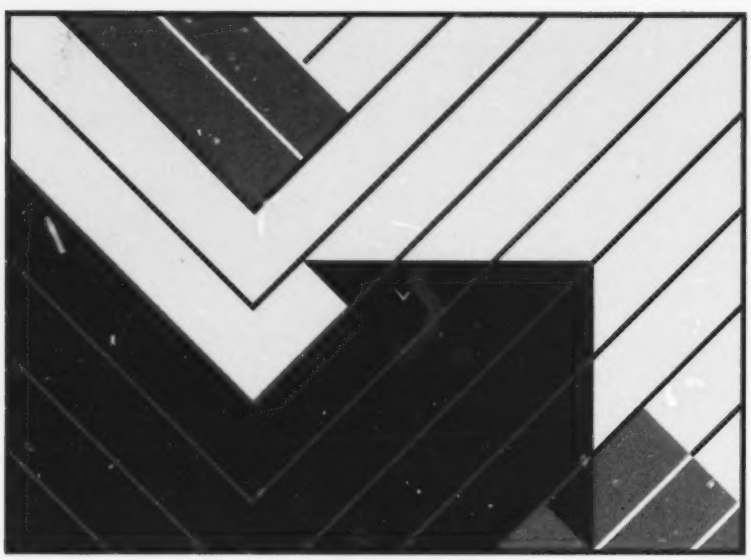
Conference on Medical Screening and Biological Monitoring for the Effects of Exposure in the Workplace

July 10-13, 1984
Cincinnati, Ohio



National Institute for Occupational Safety and Health
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Contents: Schedule; Program; Joint planning committee; Index of speakers; Presentation abstracts; Participants.

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Conference on Medical Screening and Biological Monitoring for the Effects of Exposure in the Workplace

July 10–13, 1984

Clarion Hotel
Cincinnati, Ohio

Sponsored by the
National Institute for Occupational Safety and Health
National Cancer Institute
Office of Health Research, U.S. Environmental Protection Agency

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CONFERENCE ON MEDICAL SCREENING
AND BIOLOGICAL MONITORING
FOR THE EFFECTS OF EXPOSURE IN THE WORKPLACE

SCHEDULE

Tuesday, July 10, 1984

Morning	*Grand Ballroom*
8:30 a.m.-12:00 noon	Introduction
Lunch	
Afternoon	*Grand Ballroom A*
1:30 p.m.-3:00 p.m.	Medical Screening I
3:30 p.m.-5:30 p.m.	Medical Screening II
Afternoon	*Grand Ballroom B*
1:00 p.m.-3:00 p.m.	Biomonitoring I
3:30 p.m.-5:30 p.m.	Case Studies I

Wednesday, July 11, 1984

Morning	*Grand Ballroom A*
8:30 a.m.-10:00 a.m.	Medical Screening III
10:30 a.m.-12:00 noon	Ethics
Morning	*Grand Ballroom B*
8:30 a.m.-10:30 a.m.	Biomonitoring II
11:00 a.m.-12:30 p.m.	Social Issues I
Lunch	
Afternoon	*Grand Ballroom A*
1:30 p.m.-3:00 p.m.	Genetic Susceptibility
3:30 p.m.-5:30 p.m.	Medical Screening IV
Afternoon	*Grand Ballroom B*
1:30 p.m.-3:30 p.m.	Case Studies II
4:00 p.m.-5:30 p.m.	Economics

SCHEDULE (Concluded)

Thursday, July 12, 1984

Morning	*Grand Ballroom A*
8:30 a.m.-10:00 a.m.	Genetic Effects I
10:30 a.m.-12:00 noon	Medical Screening V
Morning	*Grand Ballroom B*
8:30 a.m.-10:00 a.m.	Social Issues II
10:30 a.m.-12:00 noon	Cancer Screening
Lunch	
Afternoon	*Grand Ballroom A*
1:30 p.m.-3:00 p.m.	Bladder Cancer
3:30 p.m.-5:30 p.m.	Legal Issues
Afternoon	*Grand Ballroom B*
1:30 p.m.-3:30 p.m.	Case Studies III
4:00 p.m.-5:30 p.m.	Genetic Effects II

Friday, July 13, 1984

Morning	*Grand Ballroom*
8:30 a.m.-10:00 a.m.	Case Studies IV
10:30 a.m.-12:00 noon	Synthesis and Closing Remarks

CONFERENCE ON MEDICAL SCREENING
AND BIOLOGICAL MONITORING
FOR THE EFFECTS OF EXPOSURE IN THE WORKPLACE

PROGRAM

Tuesday, July 10, 1984

INTRODUCTION--Grand Ballroom

Moderator: Thomas J. Mason, NCI

8:30 a.m.	William E. Halperin NIOSH	Medical Screening in the Workplace: Proposed Principles
9:00 a.m.	Richard S.F. Schilling University of London	Role of Medical Examination in Protecting Worker Health
9:30 a.m.	Alan S. Morrison Brown University	Epidemiologic Issues in Screening Programs
10:00 a.m.	BREAK	

Moderator: Philip J. Landrigan, NIOSH

10:30 a.m.	Jennifer M. Ratcliffe NIOSH	Prevalence of Screening in Industry: A Report from the National Occupational Hazard Survey
11:00 a.m.	Bernard D. Goldstein U.S. EPA	The Role of Mechanistic Studies in the Development of Medical Screening and Biological Monitoring Techniques
11:20 a.m.	Peter Greenwald NCI	NCI Cancer Prevention and Control Program
11:40 a.m.	J. Donald Millar NIOSH	Screening in the Continuum of Prevention
12:00 noon	LUNCH	

Tuesday, July 10, 1984 (Continued)

CONCURRENT SESSIONS

MEDICAL SCREENING I--Grand Ballroom A

Moderator: William E. Halperin, NIOSH

1:30 p.m.	Rose H. Goldman Cambridge Hospital	The General Occupational Health History and Examination
2:00 p.m.	Bernard D. Goldstein U.S. EPA	Biological and Ambient Monitoring of Benzene in the Workplace
2:30 p.m.	Michael Thun NIOSH	The Spectrum of Tests Available to Evaluate Occupationally Induced Renal Disease
3:00 p.m.	BREAK	

BIOMONITORING I--Grand Ballroom B

Moderator: Larry K. Lowry, NIOSH

1:00 p.m.	Alfred Bernard University of Louvain	Present Status and Trends in Biological Monitoring
1:30 p.m.	Larry K. Lowry NIOSH	The Biological Exposure Index (BEI) as an Adjunct to the Threshold Limit Value (TLV)
2:00 p.m.	Aart C. Monster University of Amsterdam	Biological Monitoring of Chlorinated Hydrocarbon Solvents
2:30 p.m.	Thomas Pierce University of North Alabama	Immunoassay as a Screening Tool for Industrial Toxicants
3:00 p.m.	BREAK	

Tuesday, July 10, 1984 (Concluded)

CONCURRENT SESSIONS

MEDICAL SCREENING II--Grand Ballroom A

Moderator: Paul A. Schulte, NIOSH

3:30 p.m.	Lynne Moody NIOSH	Screening Asymptomatic Populations for Neurotoxicity
4:00 p.m.	Edward L. Baker Harvard University	Neurobehavioral Monitoring in the Workplace
4:30 p.m.	Margit L. Bleecker Johns Hopkins Medical Institutes	Carpal Tunnel Syndrome: Comparisons of Alterations in Vibration Threshold Versus Electrodiagnostic Studies
5:00 p.m.	Nortin M. Hadler University of North Carolina	Criteria for Screening Workers for the Establishment of Disability

CASE STUDIES I--Grand Ballroom B

Moderator: Richard D. Costlow, NCI

3:30 p.m.	Shelia K. Hoar NCI	Screening for Colorectal Cancer and Polyps Among Pattern Makers
4:00 p.m.	Ki Moon Bang Workers' Institute for Safety and Health	Sensitivity of Fecal Hemoccult Testing and Flexible Sigmoidoscopy for Colorectal Cancer Screening
4:30 p.m.	Kaye H. Kilburn University of Southern California	Medical Screening for Lung Cancer: Perspective and Strategy
5:00 p.m.	Elizabeth Ward NIOSH	Biological Monitoring of Workers Exposed to MBOCA

ADJOURN

Wednesday, July 11, 1984

CONCURRENT SESSIONS

MEDICAL SCREENING III--Grand Ballroom A

Moderator: Kathleen Kreiss
National Jewish Hospital and Research Center

8:30 a.m.	Mark A. Hlatky Duke University Medical Center	Exercise Tolerance Testing
9:00 a.m.	Thomas K. Hodous NIOSH	Screening Prospective Workers for the Ability to Use Respirators
9:30 a.m.	John L. Hankinson NIOSH	Pulmonary Function Testing in the Screening of Asymptomatic Workers
10:00 a.m.	BREAK	

BIOMONITORING II--Grand Ballroom B

Moderator: Larry K. Lowry, NIOSH

8:30 a.m.	Lance Wallace U.S. EPA	Concentrations of 20 Volatile Organic Compounds in the Air and Drinking Water of 350 Residents of New Jersey Compared to Concentrations in Their Exhaled Breath
9:00 a.m.	Pierre-Olivier Droz IUMTHI	Occupational Exposure Monitoring Using Breath Analysis
9:30 a.m.	Peter Bloch Hospital of the University of Pennsylvania	An X-Ray Fluorescence Technique to Measure In Vivo the Heavy Metal Burdens of Individuals Exposed to These Substances at the Workplace
10:00 a.m.	Reginald M. Griffin ESA Laboratories	Monitoring for Heavy Metals
10:30 a.m.	BREAK	

Wednesday, July 11, 1984 (Continued)

CONCURRENT SESSIONS

ETHICS--Grand Ballroom A

Moderator: Paul A. Schulte, NIOSH

10:30 a.m.	Ronald Bayer Institute of Society, Ethics, and the Life Sciences	Ethics and Worker Participation in Medical Screening and Biological Monitoring for the Effects of Exposure in the Workplace
11:00 a.m.	Gordon Atherley Canadian Center for Occupational Health and Safety	Biomedical Surveillance: Rights Conflict with Rights
11:30 a.m.	Marc A. Lappe University of California, Berkeley	Ethical Concerns of Occupational Screening Programs
12:00 noon	LUNCH	

SOCIAL ISSUES I--Grand Ballroom B

Moderator: Rose H. Goldman, Cambridge Hospital

11:00 a.m.	Lew Malter Health Evaluation Programs, Inc.	Industrial Mobile Health Testing
11:30 a.m.	David K. Parkinson University of Pittsburgh	Establishment of Medical Surveillance in Industry--Problems and Procedures
12:00 noon	Ido de Groot University of Cincinnati	Review of Thirty Years of Screening Practices
12:30 p.m.	LUNCH	

Wednesday, July 11, 1984 (Continued)

CONCURRENT SESSIONS

GENETIC SUSCEPTIBILITY--Grand Ballroom A

Moderator: Daniel G. Greathouse, U.S. EPA

1:30 p.m.	Edward J. Calabrese University of Massachusetts	The Influence of Genetic Status on Susceptibility to Environmental and Occupational Pollutants--An Overview
2:00 p.m.	Robert F. Murray, Jr. Howard University	Tests of So-Called Genetic Susceptibility
2:30 p.m.	Carol A. Newill Johns Hopkins University	Epidemiologic Approach to the Evaluation of Genetic Screening in the Workplace
3:00 p.m.	BREAK	

CASE STUDIES II--Grand Ballroom B

Moderator: Thomas J. Mason, NCI

1:30 p.m.	C.W. Stallard, Jr. Standard Oil Company	Use of SOHIO's Health Information System
2:00 p.m.	James M. Melius NIOSH	Medical Monitoring for Hazardous Waste Workers
2:30 p.m.	Molly Joel Coye NIOSH	Biological Monitoring of Agricultural Workers Exposed to Pesticides
3:00 p.m.	Sandra Tillett Workers' Institute for Safety and Health	Interventions in High Risk Occupational Cohorts: A Cross-Sectional Demonstration Project
3:30 p.m.	BREAK	

Wednesday, July 11, 1984 (Concluded)

CONCURRENT SESSIONS

MEDICAL SCREENING IV--Grand Ballroom A

Moderator: William E. Halperin, NIOSH

3:30 p.m.	Edward A. Emmett Johns Hopkins University	Dermatologic Screening
4:00 p.m.	Larry H. Royster North Carolina State University	Audiometric Data Base Analysis Considerations
4:30 p.m.	Carlo H. Tamburro University of Louisville	Tests of Hepatotoxicity Useful in Screening Workers
5:00 p.m.	Nancy Ellish Department of Health State of New York	A Pilot Study to Detect Early Pregnancy and Early Fetal Loss

ECONOMICS--Grand Ballroom B

Moderator: Paul A. Schulte, NIOSH

4:00 p.m.	Leslie I. Boden Harvard University School of Public Health	Economics of Medical Screening and Biological Monitoring
4:30 p.m.	William E. Guthier Alliance of American Insurers	Screening and Biological Monitoring as Used by the Insurance Industry
5:00 p.m.	Ruth Ruttenberg Workers' Institute for Safety and Health	The Economics of Notification and Medical Screening for High Risk Workers

ADJOURN

Thursday, July 12, 1984

CONCURRENT SESSIONS

GENETIC EFFECTS I--Grand Ballroom A

Moderator: Daniel G. Greathouse, U.S. EPA

8:30 a.m.	Anthony V. Carrano Lawrence Livermore National Laboratory	Chromosomal Alterations as Indicators of Occupational Exposure
9:00 a.m.	Andrew J. Wyrobek Lawrence Livermore National Laboratory	Optimal Design and Cohort Size Requirements for Human Studies of Induced Sperm Concentration and Morphology Effects
9:30 a.m.	Frederica P. Perera Columbia University	Potential Methods to Monitor Workers Exposed to Carcinogens: Benzo(a)-pyrene-DNA Adducts as an Example
10:00 a.m.	BREAK	

SOCIAL ISSUES II--Grand Ballroom B

Moderator: Philip J. Landrigan, NIOSH

8:30 a.m.	Sheldon W. Samuels AFL-CIO	Medical Surveillance: Ethical, Social, and Biological Perspectives
9:00 a.m.	Ambrose B. Kelly Rivendell	Loss Control and Its Place in the Insurance Industry
9:30 a.m.	Ralph E. Yodaiken OSHA	Surveillance Monitoring and Regulatory Concerns
10:00 a.m.	BREAK	

Thursday, July 12, 1984 (Continued)

CONCURRENT SESSIONS

MEDICAL SCREENING V--Grand Ballroom A

Moderator: William E. Halperin, NIOSH

10:30 a.m.	John M. Myers City of Philadelphia	A View from Inside a City Bureaucracy
11:00 a.m.	Jack Edeiken Thomas Jefferson University Hospital	The Use of Radiography for Screening Employees at Risk of Low Back Disability
11:30 a.m.	Lireka P. Joseph FDA	Use and Effectiveness of Chest Radiography and Low Back Radiography
12:00 noon	LUNCH	

CANCER SCREENING--Grand Ballroom B

Moderator: Philip C. Prorok, NCI

10:30 a.m.	Barbara S. Hulka University of North Carolina	Screening for Cancer: Lessons Learned
11:00 a.m.	Myron Melamed Memorial Sloan Kettering Cancer Center	Sputum Cytology
11:30 a.m.	John K. Frost Johns Hopkins University	Cytopathology Use and Potential in Monitoring Workplace Environments by Screening for Biological Effects of Exposure
12:00 noon	LUNCH	

Thursday, July 12, 1984 (Continued)

CONCURRENT SESSIONS

BLADDER CANCER--Grand Ballroom A

Moderator: Philip C. Prorok, NCI

1:30 p.m.	Paul A. Schulte NIOSH	Problems in Notification and Screening of Workers at High Risk of Disease
2:00 p.m.	George P. Hemstreet, III University of Oklahoma	An Improved Nuclear Fluorescence Screening Technique
2:30 p.m.	Thomas J. Mason NCI	Study of the DuPont Chambers Works Plant Bladder Cancer Screening Program
3:00 p.m.	BREAK	

CASE STUDIES III--Grand Ballroom B

Moderator: John L. Hankinson, NIOSH

1:30 p.m.	John R. Goldsmith Ben Gurion University of the Negev	Pulmonary Function Screening in Occupational Health
2:00 p.m.	Kathleen Kreiss National Jewish Hospital and Research Center	Approaches to Assessing Pulmonary Dysfunction and Susceptibility in Workers
2:30 p.m.	David C. Deubner Duke University Medical Center	One-Time Screening to Define a Problem: Legionella Exposure in an Electric Power Company
3:00 p.m.	Lawrence J. Fine University of Michigan	An Alternative Way of Detecting Cumulative Trauma Disorders of the Upper Extremities in the Workplace
3:30 p.m.	BREAK	

Thursday, July 12, 1984 (Concluded)

CONCURRENT SESSIONS

LEGAL ISSUES--Grand Ballroom A

Moderator: Rose H. Goldman, Cambridge Hospital

3:30 p.m.	Michael S. Baram Boston University School of Public Health	Uses of Biological Monitoring and Screening Data as Evidence in Legal Proceedings
4:00 p.m.	Mark A. Rothstein West Virginia University	Discriminatory Aspects of Screening
4:30 p.m.	Benjamin W. Mintz American University	OSHA Authority for Biological Monitoring and Medical Screening
5:00 p.m.	Lisa J. Raines Office of Technology Assessment	Biological Monitoring and Occupational Disease Liability

GENETIC EFFECTS II--Grand Ballroom B

Moderator: Thomas J. Mason, NCI

4:00 p.m.	Paul L. Skipper Massachusetts Institute of Technology	Analytical Methods for Assessing Exposure to 4-Aminobiphenyl Based on Protein Adduct Formation
4:30 p.m.	Richard B. Everson NIEHS	Detection of Occupational Exposures by Bacterial Mutagenesis Assays of Human Body Fluids
5:00 p.m.	Casey Jason Alexandria Physicians Group	Geographical Distribution of Unexplained Low Birth Weight

ADJOURN

Friday, July 13, 1984

CASE STUDIES IV--Grand Ballroom

Moderator: Thomas J. Mason, NCI

8:30 a.m.	Raymond A. Cartwright Yorkshire Regional Health Authority	Screening Workers Exposed to Suspect Bladder Carcinogens
9:00 a.m.	Robert S. Fontana Mayo Clinic	Lung Cancer Screening
9:30 a.m.	Rochelle Althouse NIOSH	Use of Data from the X-Ray Surveillance of Coal Miners to Evaluate the Efficacy of the Dust Standard
10:00 a.m.	BREAK	

SYNTHESIS--Grand Ballroom

Moderator: Thomas J. Mason, NCI

10:30 a.m.	George Hutchison Harvard University	
11:15 a.m.	Anthony Miller University of Toronto	
12:00 noon	ADJOURN	

JOINT PLANNING COMMITTEE

Chairmen

William E. Halperin, NIOSH
Thomas J. Mason, NCI

Paul A. Schulte, NIOSH
Richard D. Costlow, NCI
Philip P. Prorok, NCI
Daniel G. Greathouse, EPA

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PRESENTATION ABSTRACTS

Tuesday

8:30 a.m. MEDICAL SCREENING IN THE WORKPLACE: PROPOSED PRINCIPLES

William E. Halperin, J.M. Ratcliffe, T.M. Frazier, P.S. Becker, P.A. Schulte

Medical screening and biological monitoring are two techniques in a continuum of practices used to prevent occupational disease. Medical screening is the examination of workers for pathological conditions. Biological monitoring is the examination of the worker for the presence of an intoxicant or its metabolite. These techniques are common in industry, and frequently components of health standards recommended by NIOSH to OSHA. However, an underlying set of principles for medical screening and biological monitoring in the workplace has not been delineated. We propose a modification of the principles for screening in the community more appropriate for the workplace. These precepts include: (1) the disease to be prevented should be important; (2) the disease need not be treatable but must be preventable; (3) follow-up care should be planned for participants of screening programs; (4) the condition sought must have a recognizable latent or early symptomatic stage; (5) the screening test need not be uncomplicated or inexpensive; (6) professionals who utilize the tests must be skilled in their interpretation; (7) screening tests should be targeted to specific job risks; (8) the timing of tests should be determined by the natural history of the disease; (9) the test should be effective; (10) normal values for screening test results for the workforce should not be assumed to be equivalent to those values in the community; (11) action levels for test results should be decided upon before the commencement of the screening program; (12) the program should be acceptable to the workforce; and, (13) the goals of the screening program, whether identification of individuals for treatment, or evaluation of more primary preventive measures, such as environmental monitoring, should be specified. This modified set of principles is not a statement of the policy of NIOSH on this important subject, but rather a presentation of the authors' views as a starting point to begin a dialogue on these issues at this conference.

Tuesday

9:00 a.m. ROLE OF MEDICAL EXAMINATION IN PROTECTING WORKER HEALTH

Richard S.F. Schilling

Work-related disease is the product of multiple factors including host susceptibility, the external environment, and individual behavior. The concept of multiple causality is relevant to the etiology of diseases in which work and exposures are contributory agents and diseases that have a single necessary cause, e.g., lead poisoning. The objectives of medical screening in the control of work-related diseases are to (1) identify persons likely to be vulnerable to adverse effects from a particular work exposure as a result of genetic abnormalities, past or present disease, personal habits and behavior; (2) provide baseline data to identify adverse exposure effects; (3) provide group data to evaluate the effectiveness of control measures and, in conjunction with exposure levels, to establish or revise threshold limit values; (4) identify individuals in the work force who are showing evidence of undue susceptibility; and (5) make workers fully aware of the potential health risks to which they are exposed and how such risks may be contained with the combined efforts of management, themselves, and health services. Screening procedures include a wide range of questionnaires, diagnostic tests, function measurements and biological tests of exposure levels to environmental agents. Achieving the objectives of medical examinations will depend on: (1) selecting appropriate tests which are acceptable to workers; (2) discarding tests that cannot meet requirements with respect to reproducibility, specificity and sensitivity; and (3) periodic review of health surveillance programs as a whole, leading where necessary to their modification or abandonment in the light of improved working conditions.

Tuesday

9:30 a.m. EPIDEMIOLOGIC ISSUES IN SCREENING PROGRAMS

Alan S. Morrison

A review of epidemiologic issues in screening is presented. The objectives of screening are stated. The features of the natural history of a disease that make it a suitable target of screening are given. The sensitivity and specificity of a screening test are defined, and the interrelation of sensitivity and specificity is described. The predictive value of screening is defined and related to test sensitivity and specificity and the prevalence of the disease. Methods of evaluating the efficacy of screening programs are considered. The effects of lead time and of length-biased sampling on the death rate of screen-detected cases are illustrated.

The need for measurement of the effect of early treatment on the disease-specific mortality rate in an entire screened population is emphasized. Both experimental and nonexperimental approaches are discussed.

Tuesday

10:30 a.m. PREVALENCE OF SCREENING IN INDUSTRY: A REPORT FROM THE NATIONAL OCCUPATIONAL HAZARD SURVEY

Jennifer M. Ratcliffe, W.E. Halperin, T.M. Frazier, L. Delaney, R.H. Hornung

The purpose of this paper is to present an analysis of the changing prevalence of medical screening practices in U.S. industry, according to factors that affect their distribution (such as plant size, industry type, presence of unions), and to examine the relationship between provision of specific screening tests and the presence of selected chemical hazards in the workplace. Data from the first National Occupational Hazard Survey (NOHS I) (1972-1974), a stratified sample of 5,000 U.S. workplaces conducted by the National Institute for Occupational Safety and Health (NIOSH), show, for example, that an estimated 38 percent of workers were required to take preplacement examinations and 14 percent were offered periodic examinations. By 1982, these percentages had risen to 49 percent and 30 percent, respectively, according to data from the second NOHS (1981-1983). The prevalence of these examinations and the availability of on-site medical personnel are primarily determined by plant size but also vary considerably by industry type; further, plants with unions and/or industrial hygiene and safety programs are more likely to provide medical examinations (irrespective of plant size) than those without. With respect to the provision of specific periodic tests recommended by NIOSH (such as chest X-rays, blood tests) for workers potentially exposed to selected chemical hazards (e.g., lead, asbestos, mineral dusts), there is no consistent evidence from the first survey that exposed workers were more likely to receive exposure-specific tests than nonexposed workers. The significance of these findings and preliminary observations on current screening practices from the second survey will be discussed in the context of the proposed framework for medical screening practices developed by NIOSH.

Tuesday

1:00 p.m. PRESENT STATUS AND TRENDS IN BIOLOGICAL MONITORING

Alfred Bernard, R. Lauwerys

To protect the health of populations exposed to occupational or environmental pollutants, three types of monitoring can be carried out: ambient monitoring, biological monitoring of exposure, and health surveillance (also called biological monitoring of effects). Ambient monitoring evaluates the external exposure by measuring the chemical in the environment (i.e., in air at the workplace). Biological monitoring of exposure evaluates the amount of chemical effectively absorbed (internal dose). The advantage of biological monitoring is to provide a more accurate assessment of health risk than ambient monitoring: a biological parameter reflecting the internal dose is necessarily more closely related to a systemic adverse effect than any environmental measurement. The majority of the biological monitoring exposure tests rely on the measurement of the chemicals or their metabolites present in the circulation (to estimate the current exposure) or stored in one or several body compartments (to estimate the integrated exposure). In some cases, the internal dose can be estimated by the measurement of non-adverse biological effects. The current trend in biological monitoring is to develop tests providing information on the amount of chemical bound to the critical sites of action (target dose). Ambient and biological monitoring assess the health risk by comparing the current exposure with the permissible exposure limits. They are essentially two preventive activities. By contrast, health surveillance or biological monitoring of effects assesses the health status and aims at detecting the early adverse health effects. Health surveillance is part of the medical screening program for the early detection of health impairment due to industrial chemicals.

Tuesday

1:30 p.m. THE GENERAL OCCUPATIONAL HEALTH HISTORY AND EXAMINATION

Rose H. Goldman

For the Preplacement Examination (PPE), the history should include a medical history and an occupational history: prior job titles and descriptions (operating and clean-up practices, use of protective equipment, engineering controls, etc.); potential exposures; symptoms or illnesses temporally related to recent or past jobs; nonoccupational exposures. The primary goal of the PPE is to provide a "baseline" for future testing and to reveal any conditions that may predispose the worker to increased risks from job exposures so that appropriate placement or accommodations are made. Secondarily, the PPE and/or Periodic Medical Examination also provide opportunities for recommended primary care periodic health tests or health promotion activities. The contents of the

PPE depend on (1) history of past exposures; (2) potential hazards of the present job; and (3) (optional) tests recommended for general medicine periodic health maintenance and activities for health promotion. The occupational Periodic Medical Examination (PME) resembles a screening program in that it attempts to discover a disease process in any early asymptomatic period when the disease is reversible or treatable. Yet the PME differs from screening in that it seeks to detect health conditions potentially related to work, which may or may not be treatable in the affected individual, but would be treatable in the public health sense, i.e., through recognition and control of hazards so as to prevent illness in others. Medical monitoring checks the effectiveness of primary preventive programs, such as engineering controls and personal protective equipment. The contents of the PME and the frequency of testing depend on the (1) pathophysiology and toxiocology of the specific toxins or hazards; (2) interval exposure history and symptoms; and (3) requirements of standards or laws. Group results of PPEs and PMEs should be assessed periodically to look for trends or groups of symptoms that may suggest an association with workplace exposures.

Tuesday

1:30 p.m. THE BIOLOGICAL EXPOSURE INDEX (BEI) AS AN ADJUNCT TO THE THRESHOLD LIMIT VALUE (TLV)

Larry K. Lowry

The American Conference of Governmental Industrial Hygienists (ACGIH) has recognized the value of biological monitoring for assessing worker exposure to chemicals. The ACGIH has established a Biological Exposure Indices Committee to review literature, prepare documentation analogous to the widely used TLVs, and recommend Biological Exposure Indices (BEIs) for selected workplace chemicals. The BEIs represent an in-depth review of the literature and address such important issues as routes of exposure, absorption, metabolism, uptake, pharmacokinetics, sampling, methods of analysis, interferences (both chemical and metabolic), and interpretation of results. The recommended BEIs represent levels of some biological parameter that would be found in a worker following an 8-hour exposure (at moderate work) to the current TLV. To date, documentations for toluene, xylene, ethylbenzene, carbon monoxide, styrene, and trichloroethylene have been prepared and submitted to the ACGIH Board of Directors for adoption.

Tuesday

2:00 p.m. BIOLOGICAL AND AMBIENT MONITORING OF BENZENE IN THE WORKPLACE

Bernard D. Goldstein

Benzene is a potent hematotoxin capable of causing aplastic anemia and acute myeloblastic leukemia. Surveillance of workers potentially exposed to benzene is focused on detecting evidence of bone marrow toxicity. A particularly thorough hematological evaluation should be conducted upon entrance to the workforce at risk. This should be followed by at least quarterly surveillance using the routine complete blood count as the major monitoring technique. Attention should also be placed on increases in the mean corpuscular volume and decreases in the lymphocyte count as possible early indicators of benzene toxicity. Other hematological findings that may be indicative of early benzene toxicity depend upon alterations in the characteristics of blood cells, e.g., a prolongation of the red cell glycerol hemolysis time. No single finding or constellation of findings is pathognomic of benzene hematotoxicity, and all findings must be carefully interpreted in terms of the individual or group at risk. It is unlikely that any of the currently available approaches will detect individuals exposed to levels of benzene present in the general environment. Basic research into the mechanism of benzene hematotoxicity is a prerequisite to developing improved means of protecting potentially exposed populations.

Tuesday

2:00 p.m. BIOLOGICAL MONITORING OF CHLORINATED HYDROCARBON SOLVENTS

Aart C. Monster

Biological monitoring of exposure to the following volatile halogenated hydrocarbons will be discussed: monochloromethane (methyl choride), monobromomethane (methyl bromide), dichloromethane (methylene chloride), trichloromethane (chloroform), tetrachloromethane (carbon tetrachloride), 1,2-dichloroethane (ethylene dichloride), 1,1,1-trichloroethane (methylchloroform), trichloroethene (trichloroethylene), tetrachloroethene (perchloroethylene), monochloroethene (vinyl chloride). Most agents are widely used as solvents. Some are used as refrigerants, blowing agents, pesticides, or plastic monomers. All agents act on the nervous system as a narcotic; some solvents have even been widely used as anesthetics (particularly trichloroethene). Moreover, all liquid compounds have a defattening effect on the skin. Some agents also exert specific effects. The saturated chlorinated hydrocarbons, trichloromethane and tetrachloromethane, may exert severe hepatotoxic and nephrotoxic effects. Chloromethane and bromomethane may lead to severely disabling neurologic sequelae. Because of its specific biotransformation, dichloromethane acts both as a narcotic agent and

as a precursor of carbon monoxide (decreased transport and utilization of oxygen: hypoxia). To a large extent there is a great comparability in analytical gas chromatographic methods for measuring agents or metabolites in biological specimens. Moreover, the same metabolites may occur in exposure to different chlorinated hydrocarbons, e.g., trichloroethanol and trichloroacetic acid, in blood and/or urine in exposure to trichloroethene, tetrachloroethene, and 1,1,1-trichloroethane. On the other hand, these agents differ widely in the percentage metabolized, e.g., a large biotransformation in the case of trichloroethene and a minor biotransformation in the case of the other two.

Tuesday

2:30 p.m. THE SPECTRUM OF TESTS AVAILABLE TO EVALUATE OCCUPATIONALLY INDUCED RENAL DISEASE

Michael Thun

The traditional tests used to screen workers for renal disease are inadequate to detect early or moderate loss of renal function. Blood urea nitrogen, serum creatinine, and dipstick measurement of urine protein become abnormal only when renal impairment is relatively advanced and the loss of function potentially less reversible. Other, more sensitive tests, such as creatinine clearance, tests of urinary acidification, or of urine concentrating ability, are seldom measured reliably in the occupational setting. Several noninvasive tests of kidney function have proven useful in monitoring the effects of special toxins. Increased urinary excretion of beta-2 microglobulin and retinol-binding protein indicates impairment of proximal tubular reabsorption of small proteins in workers exposed to cadmium. Tubular proteinuria has also been described due to mercury, uranium, and other heavy metals. Quantitative measurement of larger proteins, such as transferrin, albumin, and immunoglobulins, may be of use in monitoring glomerular damage, as may the quantification of intact cells or casts in urine sediment. Other noninvasive tests of renal function, such as measurement of enzymuria or isolation of individual urine proteins through two-dimensional chromatography (ISO-Dalt), are still experimental. We recommend that special research projects attempt to validate the clinical significance of these and other medical tests through careful study in a controlled clinical setting.

Tuesday

2:30 p.m. IMMUNOASSAY AS A SCREENING TOOL FOR INDUSTRIAL TOXICANTS

Thomas Pierce

The concepts of biological monitoring and the use of biologic Threshold Limit Values® are hardly new ideas although their popularity has increased in recent years. The use of biological monitoring may increase knowledge concerning the worker's exposure and his response to materials. The importance of biological monitoring is heightened for substances that are believed to be significantly absorbed through dermal means because air monitoring is not wholly satisfactory. Biological monitoring has been rather heavily weighted in favor of inorganic ions and compounds on account of analytical complexities involving the organic contaminants and their metabolites. Immunoassay techniques may represent useful screening tools to assist analysts interested in the presence and amounts of organic toxicants in biological fluids. The widespread application of immunoassay methods in medicinal and forensic (drugs of abuse) chemistry has resulted in such screening methodologies. Four methodologies of potential benefit are considered: the Free Radical Assay Technique, Enzyme-mediated Immunoassay Technique, Radioimmunoassay, and Hemagglutination. Each of these immunoassays is based upon the competitive displacement of the labeled drug (or toxicant) from the antibody complex by the unlabeled drug-toxicant in the sample. The scope, limitations, and potential experimental difficulties associated with the development of immunoassays for industrial toxicants will be discussed.

Tuesday

3:30 p.m. SCREENING ASYMPTOMATIC POPULATIONS FOR NEUROTOXICITY

Lynne Moody

Environmental and occupational toxins that injure the nervous system typically affect both the central and peripheral nervous systems, but disabling disease often appears first or most prominently as peripheral neuropathy. Traditional quantitative methods for evaluating neuropathy may be problematic or insufficiently sensitive as screening tools; standard electrophysiological techniques (nerve conduction velocities and electromyography) are often no more sensitive or reproducible, and in some cases are less sensitive, than the clinical neurological exam. Because effective screening techniques must be able to detect (and preferably quantify) subclinical dysfunction in a reproducible fashion and must be acceptable to the subjects, investigators have attempted to develop quantitative and noninvasive screening techniques. Several promising methods for the evaluation of subclinical neurotoxic effects, including somatosensory and visual evoked potentials, quantitative sensory testing of temperature and

vibration, and specialized nerve conduction testing, will be discussed. The crucial issues of sensitivity, standardized test procedures, reproducibility, and practical application in the field setting are currently being examined for these and other techniques. It should be recognized, however, that a brief, directed clinical exam may currently serve as the best screening battery for certain neurotoxins. The most appropriate screening tests can be devised when the neurotoxin is identified and its effects known.

Tuesday

3:30 p.m. SCREENING FOR COLORECTAL CANCER AND POLYPS AMONG PATTERN MAKERS

Shelia K. Hoar, K. Moon Bang, S. Tillett, M. Rodriguez, K.P. Cantor, A. Blair

Pattern makers construct prototypes and can be exposed to wood, metals, fiberglass, epoxy resins, welding or soldering fumes, cutting oils, solvents, and paints. In response to a union request, the Workers' Institute for Safety and Health conducted a cancer screening program for the Pattern Makers' League of North America. As of November 1983, 1,493 white males had participated in the program, which included a colorectal flexible sigmoidoscopy. One or more colorectal polypoid lesions were found in 226 (15 percent). One rectal carcinoma and 10 colon malignancies (6 adenocarcinomas, 2 carcinomas in situ, 2 carcinoid tumors) were detected. We will discuss difficulties in obtaining appropriate "expected" numbers: (1) Prevalent detectable preclinical colon cancer is not equivalent to incident disease, and (2) the use of the flexible sigmoidoscope, a relatively new instrument, yields results that are not directly comparable to those of the rigid sigmoidoscope used previously. To obtain the "expected" number of cancers, we used an independent estimate of 5 years for the mean duration of the detectable preclinical phase. This implied we should (1) base the expected number of colon cancer cases on the age-specific incident rates among white men in the next older 5-year age group, and (2) multiply by 5 the expected cases for one year. Therefore, the 10 observed cases are compared to 3.68, an approximately threefold increase. For invasive cancer only, there is a slightly less than twofold cancer increase. Other possible adjustment procedures will be discussed. The effects of duration of employment, occupational exposures, and other factors will be presented.

Tuesday

4:00 p.m. NEUROBEHAVIORAL MONITORING IN THE WORKPLACE

Edward L. Baker, R.E. Letz

A wide variety of workplace exposures has been shown to cause both transient and persistent derangements of central nervous system function. Organic solvents, lead, and pesticides are among the most important groups of such toxins. According to estimates from the National Occupational Hazards Survey (NOHS), millions of U.S. workers are exposed to these agents in their work. Following the development of several neurobehavioral test batteries by occupational health research units, a NIOSH/WHO expert committee met in May 1983 and developed recommendations for a core test battery and for tests that can supplement the core. The rationale and specific recommendations of that group will be discussed. In our research, we have adapted tasks from the NIOSH/WHO core battery for administration by a microcomputer. The resulting neurobehavioral assessment system (NAS) provides tasks that evaluate memory, psychomotor function, verbal ability, and mood and can be administered to large groups with minimal interviewer involvement. Validation studies comparing the computer system to standard tasks have shown high correlation between the two approaches. Reproducibility was also high. This tool appears to offer promise for future efforts to monitor central nervous system function in exposed workers.

Tuesday

4:00 p.m. SENSITIVITY OF FECAL HEMOCCULT TESTING AND FLEXIBLE SIGMOIDOSCOPY FOR COLORECTAL CANCER SCREENING

Ki Moon Bang, S. Tillet, S.K. Hoar, A. Blair, V. McDougall

Fecal Hemoccult testing and flexible sigmoidoscopy have been proposed as means of screening for colorectal cancer in the general population, as well as in identified high-risk groups. The Workers' Institute for Safety and Health conducted a colorectal cancer screening program, with partial support from the National Cancer Institute, for the Pattern Makers' League of North America. A total of 1,479 white males were screened with fecal Hemoccult testing and flexible sigmoidoscopy (up to 65 cm) during the period 1981 to 1983. The fecal Hemoccult test after diet restriction was positive in 38 (2.6 percent) men. Among 12 colorectal cancers, including in situ cases, only 3 were positive by this test. The sensitivity of this test for picking up cancer is only 25 percent. The positive predictive value is 7.9 percent. All positives by the Hemoccult testing or flexible sigmoidoscopy were examined with colonoscopy and/or barium enema for further diagnosis. Screening with fecal Hemoccult testing has been shown to be feasible and productive, but its sensitivity is low. The sensitivity of flexible sigmoidoscopy is much

higher than that of the fecal Hemoccult test. The critical issue of whether to screen asymptomatic patients for colorectal cancer is related to expected benefits, sensitivity and specificity of available screening and diagnostic tests, prevalence, cost-effectiveness, and patient compliance. A number of factors related to the sensitivity and specificity of the test will be presented.

Tuesday

4:30 p.m. CARPAL TUNNEL SYNDROME: COMPARISONS OF ALTERATIONS IN VIBRATION THRESHOLD VERSUS ELECTRODIAGNOSTIC STUDIES

Margit L. Bleecker, R. Moreland

Due to the ever increasing problems associated with carpal tunnel syndrome (CTS) in the workplace, a reliable method to measure nerve function is needed. Classically, nerve conduction studies (NCS) have been employed but are not suitable for the worksite. Because fingertip vibration perception is altered in CTS, a comparison of this measurement versus standard electrodiagnostic testing was performed. Vibration perception was measured in the median-innervated II digit and compared to the ulnar-innervated V digit using an Optocon (Op) tactile stimulator, a portable, battery-powered unit. Ten individuals (15 wrists) with no evidence of CTS by history, physical findings, or NCS had a difference in mean vibration threshold between the II and V digits of 0.369 Hz + 0.21 SD. In 25 individuals (31 wrists) who had clinically apparent CTS by history and examination, there was a mean II-V difference of 2.03 Hz + 1.19 SD ($p<.01$). Of the 31 wrists referred for CTS, 11 wrists had NCS +/ Op+ with a II-V difference of 2.27 Hz + 1.02 SD; 12 wrists were NCS -/ Op+ with a mean II-V difference of 2.30 Hz $\pm$ 1.22 SD, and 4 wrists with HCS +/ Op- had a mean difference of 0.56 Hz + 0.30 SD. Finally, 4 wrists whose clinical status was compatible with CTS had NCS -/ Op- with a mean difference of 0.87 Hz $\pm$ 0.61 SD. Therefore, nerve conduction studies were able to identify 50 percent of CTS cases, while 76 percent were positive with the Optocon having a II-V difference greater than 1 Hz. Recovery of vibration perception with treatment of CTS is presently being followed.

Tuesday

4:30 p.m. MEDICAL SCREENING FOR LUNG CANCER: PERSPECTIVE AND STRATEGY

Kaye H. Kilburn

Cancer is caused by environmental exposure. Some historical examples are Agricola's finding of lung cancer in miners exposed to radon, Potts connecting scrotal cancer to coal tar in chimney sweeps, bladder cancers found in dye workers by Rehm, and lung cancer in asbestos workers by

Mereweather, Doll, and others. Current dogma holds that most cancers result from a two-stage process of induction and promotion. Because cancer induction probably occurs in the first three decades of life in most of the population, cancer control and prevention aim to prevent or reverse promotion. The three strategies are: first, primary prevention which removes the promoter and is not only most logical, but is the practical strategy for the workplace. Second is chemoprevention which would supply antipromoters chronically as dietary supplements or medications (vitamins A,E,C, and selenium). Third is screening and prompt treatment of small cancers. Such a strategy could be perfected and tested in occupational groups with very high risk. Examples include bladder cancer in beta-naphthylamine dye workers and lung cancer in asbestos-exposed shipyard workers who smoke cigarettes. For the latter, the relative risk can be assigned on the basis of (1) age, (2) years from asbestos exposure and cigarette smoking amount, recency and age at onset. Surveillance could be chest X-ray at 4-month intervals and sputum cytology in current smokers and those within 10 years of cessation. Monoclonal antibody tests for adenocarcinoma and other marker molecules can be explored for detection. Prompt conventional treatment would be assured. Other inquiries would be directed at new treatment, such as with targeted molecules directed at surface antigens.

Tuesday

5:00 p.m. CRITERIA FOR SCREENING WORKERS FOR THE ESTABLISHMENT OF DISABILITY

Nortin M. Hadler

The term disability operates within very narrow confines in the current medicolegal climate. These constraints relate to the historical intent of the two principal insurance schemes operating in the United States today. The intent of the Social Security Disability Insurance (SSDI) Program is to insure against poverty consequent to the inability to maintain substantial gainful employment. Worker's Compensation Insurance schemes insure for a disability defined as wages lost consequent to a personal injury that arose out of and in the course of employment. In order to do justice to these intents, both programs have evolved models for disability determination that color the entire climate in which workers come to grips with the illness or work incapacity. Disability determination in these programs traditionally is based on the classical medical disease-illness paradigm; if one defines the quantity of disease (pathoanatomical abnormality), one can predict the magnitude of illness, including the fashion in which the illness will operate in the workplace. This inference underlies the Handbook of SSDI and the early attempts at "schedules" in Worker's Compensation. The reliability and validity of this inference, however, leave much to be desired, as will be demonstrated. The alternatives currently utilized include the "expert opinion," even when

based on direct examination, which is heavily utilized in both programs. The opinion of the worker's personal physician is relied upon only before the Administrative Law Judge in the SSDI program. Testing the reliability and validity of all of these alternatives will be discussed.

Tuesday

5:00 p.m. BIOLOGICAL MONITORING OF WORKERS EXPOSED TO MBOCA

Elizabeth Ward, D. Clapp

4,4'-Methylenebis (2-chloroaniline) (MBOCA) is an animal carcinogen, used commercially as a curing agent for isocyanate-containing polymers. Although there are no adequate studies documenting health risks for MBOCA in humans, it is structurally similar to other aromatic amines that cause bladder cancer in occupationally-exposed workers. Presently, there are no Federal regulations for the control and monitoring of MBOCA exposure in the workplace. Since the late 1970s MBOCA users have relied on urinary monitoring as the primary method of assessing MBOCA exposure in the workplace. Acceptance of this method was increased by the development of an inexpensive, semi-quantitative assay for parent MBOCA in urine by a commercial laboratory (Chromometrics Laboratory in Park Ridge, Illinois), which has provided this service to over 50 polyurethane manufacturers. The presentation will (1) outline uncertainties about MBOCA's metabolism in humans that complicate interpretation of urinary MBOCA results; (2) describe alternative laboratory techniques for measuring MBOCA in urine; and (3) discuss our observations from site visits concerning practical application of urinary monitoring, including selection of workers for sampling, frequency and timing of samples, and "incentive programs" based on urinary monitoring results. We will conclude by outlining recommendations to improve the efficacy of monitoring programs for urinary MBOCA.

Wednesday

8:30 a.m. EXERCISE TOLERANCE TESTING

Mark A. Hlatky

Exercise testing has proven value for the diagnosis of cardiac disorders in symptomatic patients and for the objective measurement of functional capacity. Use of exercise tests to screen for cardiac disease in asymptomatic individuals remains controversial because of the low prevalence of disease in the population tested, the different characteristics of the test in asymptomatic individuals, and the uncertain value of the information generated. In a population with low prevalence of disease, Bayes' rule predicts that false positive tests will outnumber true positives.

Yield of screening exercise tests would be increased by limiting testing to high risk groups. The presence of hypertension, smoking, male sex, increased age, elevated cholesterol, diabetes, obesity, and a positive family history are known risk factors. Risk is particularly increased in those with multiple risk factors. Occupation per se has not been established as an independent risk factor, but the consequences of sudden cardiac symptoms in certain occupations (e.g., pilots) may justify targeted screening programs. Some characteristics of the exercise test limit its utility for screening: (1) Exercise tests are negative more often in asymptomatic individuals with anatomic coronary disease than in those with symptoms; (2) exercise tests are also less likely to be positive in patients with early disease; and (3) false positive tests are also more likely at the higher heart rates used in screening. An abnormal screening exercise EKG should be further evaluated with a radionuclide study, and, if needed, coronary arteriography. If asymptomatic coronary disease is discovered, however, no therapy is of proven benefit in prolonging life or preventing myocardial infarction. Because of the high cost and the uncertain benefit of screening exercise tests, they are rarely, if ever, indicated.

Wednesday

8:30 a.m. CONCENTRATIONS OF 20 VOLATILE ORGANIC COMPOUNDS IN THE AIR AND DRINKING WATER OF 350 RESIDENTS OF NEW JERSEY COMPARED TO CONCENTRATIONS IN THEIR EXHALED BREATH

Lance Wallace, E. Pellizzari

Twenty volatile organic compounds were measured in the personal air and drinking water of 350 residents of Bayonne and Elizabeth, New Jersey, in the fall of 1981. Two consecutive 12-hour integrated personal air samples and two tap water samples were collected from each participant. At the end of the 24-hour monitoring period, each participant supplied a sample of exhaled breath. Simultaneous outdoor samples were collected in 100 residential locations in the two cities. Participants were selected by a two-stage probability sampling scheme to represent the entire population above the age of six. Major stratification variables were socioeconomic class, proximity to chemical manufacturing or petroleum refining plants, and occupation. All participants answered a detailed questionnaire and kept a record of their activities on the day they were monitored. Eleven compounds were present much of the time in air, but only four (the trihalomethanes) in water; wide ranges of exposures (3 to 4 orders of magnitude) were noted for most compounds. Ten of 11 compounds displayed significant correlations between air exposures and breath concentrations; the 11th (chloroform) was correlated with drinking water exposures. We conclude that breath measurements are a feasible, cost-effective, and highly sensitive way to determine environmental and occupational exposures to volatile organic compounds.

Wednesday

9:00 a.m. SCREENING PROSPECTIVE WORKERS FOR THE ABILITY TO USE RESPIRATORS

Thomas K. Hodous

A physician should make the determination of the ability to use respirators, taking into account the employee's health, the respirator, and the work conditions. A medical history and at least a limited exam are recommended. While a chest X-ray and/or spirometry may be medically indicated in some fitness determinations, they should not be routinely done. The fitness testing exercise should be expanded to serve as an important aspect of the overall determination of ability to use respirators. The recommended periodicity of fitness exams varies, but could be as infrequent as every 5 years. Examining physicians should realize that usually the main stress of heavy exercise with a respirator is on the cardiovascular system and that heavy (e.g., self-contained, atmosphere-supplying) respirators can substantially increase this stress. Accordingly, exercise stress tests, with electrocardiographic monitoring, should be considered in these circumstances when cardiovascular risk factors are present. Based on limited evidence, it seems that subjects with a modest degree of lung disease can satisfactorily tolerate the pulmonary stresses of a respirator. Although conflicting data exist, it seems that the positive pressure feature, found in some respirators, does not unduly stress the cardiopulmonary system. These above points and other suggested physician guidelines will be discussed in the presentation. Available literature will be noted that should help physicians screen prospective workers for the ability to use respirators.

Wednesday

9:00 a.m. OCCUPATIONAL EXPOSURE MONITORING USING BREATH ANALYSIS

Pierre-Olivier Droz, M.P. Guillemin

Breath analysis has been proposed on numerous occasions for monitoring solvent exposure. Nevertheless, it is still rarely used routinely because of (1) difficulties in the methodology itself (sampling and analysis) and (2) lack of data concerning its relationship to exposure dose. The various methods available today are briefly reviewed, compared, and discussed. Emphasis is on the simultaneous use of CO_2 as a respiratory index. The advantages and limitations of breath analysis for occupational exposure monitoring are discussed using data obtained in experimental, field, and simulation studies. Trichloroethylene, tetrachloroethylene, methylchloroform, toluene, styrene, and ethyl acetate are taken as examples of solvents showing various pharmacodynamic properties. Finally, breath analysis is compared to other biological monitoring methods.

Wednesday

9:30 a.m. PULMONARY FUNCTION TESTING IN THE SCREENING OF ASYMPTOMATIC WORKERS

John L. Hankinson

Pulmonary function tests, and in particular spirometry, have proved to be useful tools in the medical surveillance of workers exposed to respiratory hazards. This paper is a brief guide to assist those in the medical profession who wish to establish or improve their medical surveillance programs. The following summary recommendations are made. (1) A comprehensive medical and occupational questionnaire is an essential component of any occupational medical surveillance program. (2) Spirometry tests should be carried out in accordance with the American Thoracic Society (ATS) and NIOSH recommendations. (3) Technicians who administer pulmonary function tests should complete a NIOSH-approved course on spirometry. The NIOSH spirometry workbook and manual are excellent sources of practical information. (4) Although the ATS and ACCP recommend the use of the residual method of comparing a subject's observed spirometric results with predicted, no single method is believed to be superior. Therefore, at this time, both the residual and percent predicted methods are regarded as acceptable. (5) Short-term longitudinal studies have considerable within subject variability, and therefore, either larger annual declines must be observed or the subject must be observed for a long period of time to detect true small annual decrements. Multiple initial baseline exams are needed to establish reference values for estimating annual decrements. (6) Several predicted normal studies are reviewed, including a recent NIOSH study of nonexposed, asymptomatic, active workers. The reference normal values of Knudson, Crapo, or NIOSH are all acceptable, depending on which values best reflect your population. (7) For black subjects, if normal reference values from a white population are used, then a correction factor of 0.85 is recommended.

Wednesday

9:30 a.m. AN X-RAY FLUORESCENCE TECHNIQUE TO MEASURE IN VIVO THE HEAVY METAL BURDENS OF INDIVIDUALS EXPOSED TO THESE SUBSTANCES AT THE WORKPLACE

Peter Bloch, I.M. Shapiro

Previous studies have evaluated heavy metal exposure such as mercury, lead, etc. through blood, urine, or hair analysis. The heavy metal content of body fluids and hair depends on the time since the heavy metal exposure, the mode of intake, and its excretion and sequestration by different tissues. While these assays of hair and body fluid concentrations may be a valuable measurement of acute exposure to heavy metal, they do not give an insight into the total

heavy metal intake when the intake is low and chronic. In contrast, utilizing an X-ray fluorescence technique (XRF), measurements of the long-term retention of various heavy metals in select tissues can be determined in vivo. For example, XRF of tissues irradiated in vivo was used to measure the mercury content of head and bone tissue in 298 dentists who had long-term exposure (typically 20 years) in their professional life to mercury-containing amalgams. Nearly 30 percent of the dentists had discernible levels of mercury, greater than 20 micrograms/gram in head tissue. This finding alone does not mean that the dentists were suffering from mercury toxicity; indeed, no classical signs of mercurialism were noted in any of the studied population. The health defects associated with the low-level mercury detected were subclinical, demonstrable in neurological and neuropyschological tests. The XRF technique was also used to evaluate lead in select individuals suspected of having heavy lead exposure at the workplace. In addition, it was used to assay the lead levels in 300 urban and 200 rural children to see the impact of environmental lead exposure on childhood lead retention. The X-ray fluorescence method of assaying heavy metals in vivo is noninvasive, safe, rapid, and sensitive to levels of many heavy metals that accumulate in human tissues. The X-ray exposure necessary to do the heavy metal analysis is approximately 30 millirems over approximately 1 cm^2 area. This is equivalent to approximately one-tenth of the exposure from a dental X-ray.

Wednesday

10:00 a.m. MONITORING FOR HEAVY METALS

Reginald M. Griffin

The presentation will cover some of the practical concerns associated with performing routine analyses of heavy metals in various biological matrices. The major metals that will be discussed are cadmium, lead, mercury, and arsenic. Particular attention will be given to the sample collection, transportation, analysis quality control, and dietary factors that may impact upon the quality of the resulting analytical values. The cost effectiveness of monitoring for heavy metals will also be addressed.

Wednesday

10:30 a.m. ETHICS AND WORKER PARTICIPATION IN MEDICAL SCREENING AND BIOLOGICAL MONITORING FOR THE EFFECTS OF EXPOSURE IN THE WORKPLACE

Ronald Bayer

The screening and monitoring of workers for the impacts of workplace exposure are central elements in the evaluation of current standards of protection. As such, screening and monitoring could play an important role in the enhancement of worker protection. However, because such medical surveillance may be undertaken by management under conditions that afford workers little or no job security, suspicion and conflict surround efforts to undertake such procedures. This paper addresses the following questions: Do workers have a moral obligation to participate in workplace screening and monitoring when undertaken to enhance the interests of occupational health? What conditions would be necessary to establish the existence of such a moral obligation? If such an obligation were to be established, ought it be satisfied solely on the basis of voluntary collaboration? Is compulsory participation in monitoring and screening ever morally justified? Ought the principle of informed voluntary consent that obtains in medical research apply to workplace investigations that involve potentially invasive procedures and risks to privacy?

Wednesday

11:00 a.m. BIOMEDICAL SURVEILLANCE: RIGHTS CONFLICT WITH RIGHTS

Gordon Atherley

For safety in gassy mines, canaries sensed fatal gases; instruments do it now. For hygiene in toxic industries, instruments sensed harmful exposures; workers' bodies do it now. Legislating canaries as death detectors would get international condemnation; legislating workers as dose meters gets approval almost without question. The Canadian Uranium Tissue Registry proposed the ultimate in medical surveillance and biological monitoring. The uranium miners' outrage brought recognition, at last, that in biomedical surveillance the rights of companies to self-protect, governments to probe, unions to pressure, and researchers to research conflict with the rights of workers not to have their bodies violated, privacy invaded, earning power impaired, disabilities labeled, or employment prospects harmed. Are we troubled by the trend to biomedical surveillance?

Wednesday

11:00 a.m. INDUSTRIAL MOBILE HEALTH TESTING

Lew Malter

There is a need for a source of health testing services for business and industry. This need is required by small companies without adequate medical support, especially with occupational experience. This need is required by larger companies desiring to bring health testing to their smaller and more remote facilities. There is a need for mobile services to deliver uniform, quality programs. There is a need to provide ethical, confidential programs. There is a need to contain health care costs. Mobile health service companies can supply these needs.

Wednesday

11:30 a.m. ETHICAL CONCERNS OF OCCUPATIONAL SCREENING PROGRAMS

Marc A. Lappé

Preventive and anticipatory programs for identifying workers at higher than normal risk for occupational injury and/or disease may now draw on an expanding net of sophisticated diagnostic tests. The latest category of test systems relies on use of reagents developed through recombinant DNA technologies. These reagents, including DNA probes, monoclonal antibodies, and restriction fragment length polymorphisms (RFLPs), increase the number of presumptive disorders that may be anticipated through analysis of their underlying genetic defect or predisposing molecular basis. Among the newest categories of disease entities to become detectable are some single gene abnormalities with late onset (Huntington's chorea); protective protein deficiencies (alpha-1-antitrypsin deficiency); and human leukocyte antigen markers predictive of autoimmune or related diseases (HLA B-27). The potential benefits and risks (of an ethical kind) associated with putting these tests into pre-employment occupational testing regimes will be discussed. Similar analyses will be made of on-job testing for concurrent damage, again relying on recombinant DNA-based tests of genetic or mutational damage. Assessments of the readiness of these technologies to move into the workplace, their predictive value, and the locus of control of the data generated by their use will comprise the epicenter of the discussion. Legal and ethical issues of privacy, confidentiality, responsibility for health protection, and disclosure will be reviewed. The key issue of risk-equity will be discussed as a basis for resolving conflicts among the values served by this form of testing, along with the basic protections of equal employment opportunity and worker safety.

Wednesday

11:30 a.m. ESTABLISHMENT OF MEDICAL SURVEILLANCE IN INDUSTRY--PROBLEMS AND PROCEDURES

David K. Parkinson

Although several types of examination are done in industry, the overwhelming reason for their performance is the early detection of disease. In addition, many morbidity studies require data from a medical surveillance program. As the physician's approach is traditionally clinically oriented, it is important that the limitations of screening programs be made clear. Medical surveillance falls naturally into three parts: history, examination, and special tests. The presentation will discuss the establishment of standard history-taking and give examples of such histories developed in our clinic. The development of a protocol for performing and recording physical examinations will also be described. Special tests, such as pulmonary function and sputum cytology, will then be discussed. Calculations of their predictive value, based upon sensitivity and specificity, can be established in the worker group to be studied. The integration of medical data into a data base will also be discussed with examples taken from the program in Pittsburgh. Presentation of the problems of obtaining adequate early medical information leads to the conclusion that medical surveillance programs must be integrated with industrial hygiene surveillance. The use of exposure measures to make and implement preventive medical decisions is essential until medical science provides tests with enhanced sensitivity and specificity for use in early detection of workplace disease.

Wednesday

12:00 noon REVIEW OF THIRTY YEARS OF SCREENING PRACTICES

Ido de Groot, C.K. O'Toole

Increasingly larger proportions of our population are insured against health care costs through negotiated or mandated contracts involving active and retired workers and their dependents. Seeking to control and contain the dramatically rising costs, employers have begun to demand full accountability from their third-party payors, in response to which the health care services delivery system is evolving HMOs, PPOs, IPAs, and variant aggregates of participants with more homogeneously predictable utilization rates and cost estimates. The resultant information base generates employer-specific data leading to earlier detection and identification of work-related and total premorbidity and morbidity causing the renewed emphasis on prevention through total, including work-site related, risk-factors reduction. We review here the screening technology required for the

implementation and evaluation of health risks assessment and reduction programs, a technology having matured especially over the past 30 years. Problem areas and action needs are identified.

Wednesday

1:30 p.m. THE INFLUENCE OF GENETIC STATUS ON SUSCEPTIBILITY TO ENVIRONMENTAL AND OCCUPATIONAL POLLUTANTS--AN OVERVIEW

Edward J. Calabrese

This paper will provide an introduction to the concept of ecogenetics, including its historical foundations. Specific genetic conditions (more than 30), including red blood cell and liver conditions, serum proteins, skin disorders, DNA repair diseases, and others that either theoretically or experimentally have been shown to enhance susceptibility to toxic substances, will be identified and evaluated with respect to their capacity to enhance risk, their frequency in the population, and their ability to be identified in screening tests.

Wednesday

1:30 p.m. USE OF SOHIO'S HEALTH INFORMATION SYSTEM

C.W. Stallard, Jr.

A computerized system utilizing concepts of profiling and problem orientation will be described and examples of its use demonstrated. The system contains or accesses files on employee demography, job history and current task lists, inventory of workplace risks categorized as physical, chemical, and functional, a master chemical inventory, and individual exposure records. A complete medical file utilizing SNOMED codes catalogs all physiological and pathological variables, disease states, and functional responses. Profiling exposures and medical conditions enhances inquiry of the large data base accumulated.

Wednesday

2:00 p.m. TESTS OF SO-CALLED GENETIC SUSCEPTIBILITY

Robert F. Murray Jr.

During the past two decades a number of inherited polymorphic proteins and enzymes have been identified in different ethnic groups. The biochemical characteristics of some of these and the disease associations of others suggest that theoretically, they might be used to identify individuals who

are most likely to suffer morbid or fatal effects from being exposed to certain environmental agents or conditions. Persons at risk for serious harm might then be able to avoid or be protected from these harmful effects. This idea has special implications for the workplace in view of the increasing emphasis that is being placed on the prevention of disease and injury in the workplace. This presentation will attempt to review the potential for certain of the biochemical markers that appear to be associated with susceptibility to harmful effects of the environment to be used to determine whether affected individuals ought to be excluded from certain jobs or from the environment(s) or specific settings in the workplace. It will also attempt to identify the criteria that should be used before it is scientifically and ethically justified to use these markers to "protect" workers and/or individuals from harm by not allowing them to choose to work in a specific setting or with specific agents to which they have been deemed to be at special risk for injury.

Wednesday

2:00 p.m. MEDICAL MONITORING FOR HAZARDOUS WASTE WORKERS

James M. Melius

The efforts to clean up hazardous waste disposal sites have led to an increasing number of workers involved in these activities. Industrial hygiene surveys have demonstrated that these workers are potentially exposed to low levels of multiple contaminants over the workday and to high levels of some contaminants for very short time periods. Personal protective equipment and work practices are important components in protecting workers from these exposures. Medical monitoring for these workers is problematic. While monitoring for the potential health effects of these multiple exposures may be useful, any attempt to monitor for possible health effects of all potential exposures could lead to a long array of medical tests. The utility and effectiveness of this approach is doubtful. Screening for physical ability to conduct hazardous waste cleanup jobs while wearing protective equipment is also important and may cause difficulties due to our limited knowledge in this area. These issues will be discussed in the context of various programs designed to monitor these workers.

Wednesday

2:30 p.m. EPIDEMIOLOGIC APPROACH TO THE EVALUATION OF GENETIC SCREENING IN THE WORKPLACE

Carol A. Newill, M.J. Khoury, G.A. Chase

To evaluate the potential usefulness of a proposed screening program, the positive predictive value and sensitivity of the test must be estimated and their relative importance weighed. As will be shown, it is not always possible to maximize both. The authors have derived formulas relating positive predictive value (PPV) and sensitivity to genetic marker frequency, disease frequency, and relative risk (RR). In a highly sensitive screening program, a large proportion of workers who are at highest risk of disease will be identified, and there will be few "false negative" persons. In a program with a high positive predictive value, a large proportion of workers with a positive test will be those at highest risk of disease, and few "false positives" will be identified. PPV and sensitivity are affected independently by characteristics of the population being screened. For example, for a given disease frequency, when the genetic marker is less frequent than the disease, PPV increases with relative risk although sensitivity remains low; thus for alpha-1-antitrypsin deficiency and chronic obstructive airways disease (RR=30), PPV exceeds 95 percent although sensitivity is less than 1 percent. When the genetic marker is more frequent than the disease, PPV remains low while sensitivity increases with RR; thus for HLA-B27 and ankylosing spondylitis (RR nearly 100), sensitivity is 90 percent but PPV is less than 2 percent. When marker and disease frequencies are equal, PPV and sensitivity are equal and increase with RR. However, when the disease frequency is very low, the RR must approach 100 before PPV or sensitivity approaches 50 percent. These relationships may be utilized effectively in the decision whether to implement a screening program in the workplace.

Wednesday

2:30 p.m. BIOLOGICAL MONITORING OF AGRICULTURAL WORKERS EXPOSED TO PESTICIDES

Molly Joel Coye, K.T. Maddy

Cholinesterase determination is the only form of periodic biologic monitoring currently provided to agricultural workers potentially exposed to pesticides. Interpretation and use of these measurements are complicated by factors including wide intra- and inter-individual variability in cholinesterase activity levels, the frequent lack of pre-exposure baseline levels, and poor correlation with CNS symptoms of moderate organophosphate/carbamate poisoning. NIOSH investigations of cholinesterase recovery rates in fieldworker poisonings, the use of post-exposure sequential cholinesterase

values for case management and return-to-work policies, and the utility of an immunologic technique for measurement of total serum cholinesterase to estimate postexposure inhibition are presented, with results obtained by the California Department of Food and Agriculture (CDFA) in cholinesterase monitoring of agricultural applicators for the past eight years. Other biologic indicators of exposure to and physiologic effect of specific pesticides are reviewed, with particular attention to techniques appropriate for field research, monitoring on a limited basis, and evaluation of worker exposures in registration and labeling programs. CDFA experiences in evaluation of field exposures to chlordimeform, chlorothalonil, ethylene bisdithiocarbamate (metabolite ethylene thiourea), and other compounds are described.

Wednesday

3:00 p.m. INTERVENTIONS IN HIGH RISK OCCUPATIONAL COHORTS: A CROSS-SECTIONAL DEMONSTRATION PROJECT

Sandra Tillett, K. Ringen, V. McDougall, M. Powers

Numerous groups of workers face an increased risk of developing cancer and other chronic disease due to past workplace exposures. Little has been done to notify them of their increased risk or to develop interventions aimed at cancer prevention and control on their behalf. In 1980 the Workers' Institute for Safety and Health began a demonstration project* designed to develop a model program of community-based intervention in three cohorts with different exposures and target cancer sites. Program components included: identification, notification, medical surveillance, education, social support services (e.g., psychosocial, legal, financial, etc.), and evaluation. The three cohorts included: (1) the Augusta cohort--involving 1,113 living, predominantly black, male non-union workers who face a 4 to 111-fold increase in relative risk for bladder cancer due to workplace exposure to beta-naphthylamine during the period 1949-1972; (2) the Port Allegany cohort--involving 1,186 white male members of the Flint Glass Workers Union in Port Allegany, Pennsylvania, who have a high risk of cancer associated with a workplace exposure to asbestos between 1964-1972; and (3) the Pattern Makers cohort--involving a nationally dispersed cohort of approximately 12,000 predominantly white male members of the Pattern Makers' League of North America who have been shown to be at approximately a two-fold risk of colorectal cancer by three independent epidemiologic studies reported in 1980. Together, these three projects give a cross-sectional view of possible approaches to educational and medical intervention strategies in diverse situations.

*With support from NCI grant "IR18 CA 27583.

Wednesday

3:30 p.m. DERMATOLOGIC SCREENING

Edward A. Emmett

Screening of workers may take place at preplacement examinations, periodic examinations, or as part of systematic surveys of worker health. Screening examinations may be performed to (1) detect conditions that place the worker at increased risk, so that risk might be reduced; (2) detect early signs of specific occupational diseases; or (3) systematically record cutaneous abnormalities so that increases in prevalence or incidence associated with workplace exposures can be identified. Some of the available methods will be discussed, with attention to ways in which the effectiveness of screening may be enhanced. Conditions for which such procedures may be useful include dermatitis, acne, chloracne, pigmentary changes, melanoma, and non-melanoma skin cancer. The importance of biologic monitoring in relation to cutaneous exposure is also discussed.

Wednesday

4:00 p.m. AUDIOMETRIC DATA BASE ANALYSIS CONSIDERATIONS

Larry H. Royster, J.D. Royster

An appropriate analysis of the audiometric data base offers the most direct means of judging the effectiveness of a hearing conservation program (HCP) in preventing occupational hearing loss. However, if factors that affect analysis findings are not properly considered, then the results can easily be misleading. This paper will present case history studies to illustrate the parameters that influence the interpretation of group data analysis in correctly judging the effectiveness of HCPs. Testing factors that affect the stability of the data base include audiometric techniques, calibration procedures, testing environment, and motivation and prior test experience of the subject. Pertinent population parameters include age, sex, race, current and prior noise exposures, learning effects, and types of hearing protectors in use. Critical procedural variables in audiometric data base analysis involve the models utilized to account for effects of nonindustrial noise exposures and aging. Specific data base analysis procedures to be reviewed include comparisons of mean thresholds for selected worker groups to hearing levels for nonindustrial noise-exposed populations, rates of change in mean hearing levels over time, baseline and sequential test-retest comparisons, and the utilization of different significant threshold shift criteria.

Wednesday

4:00 p.m. ECONOMICS OF MEDICAL SCREENING AND BIOLOGICAL MONITORING

Leslie I. Boden

This paper discusses medical screening and biological monitoring from an economist's perspective. The benefits and costs of testing are described, including health benefits, direct costs of testing, and labor market impacts. Economic measures of effectiveness are developed and compared with the usual epidemiologic measures of value (sensitivity, specificity, etc.). Finally, areas of divergence between social and private benefits of medical screening and biological monitoring are highlighted. The incentives created by these differences suggest areas where medical screening and biological monitoring should be used with great care and others that may be the appropriate subjects of regulation.

Wednesday

4:30 p.m. TESTS OF HEPATOTOXICITY USEFUL IN SCREENING WORKERS

Carlo H. Tamburro, G. Liss

Medical screening and biological monitoring for the effects of exposure in the workplace remain the major methods for protecting and maintaining occupational health and safety. The liver functions both as a major line of defense and source of xenobiotic toxicity. Assessment of these two functions is diverse and complex. It must be addressed in three phases: medical screening, biological monitoring, and clinical evaluation. Both a general and specific approach is needed in medical screening and biological monitoring, depending on the occupation and agents involved. Tests of hepatotoxicity in the general approach must be selected to identify all seven different types of exposure effect--cytotoxicity, cholestasis, fibrosis, vascular injury, metabolic dysfunction, impairment of RES, and carcinogenesis--while specific tests need only identify one or more. Tests for medical screening are selected for maximum sensitivity, and biological monitoring tests for maximum specificity. The liver's multifunctional character requires using sets of tests that include blood, urine, breath, isotopic, sonic, radiologic, histologic, and genetic tests. Traditional studies (e.g., enzymes, proteins) are evaluated for their specificity, sensitivity, selectivity, and cost-effectiveness for medical screening versus biological monitoring. Status of newer tests undergoing evaluation (e.g., clearance, radioisotopic assay, scans) will be reviewed, and developing tests (e.g., molecular, genetic) for occupational use will be introduced. Finally, practical application of these tests will be reviewed regarding clinical evaluations, interpretation, and triage. Illustration of their medical-socioeconomic implication at initial medical screening and during biological monitoring will be given.

Wednesday

4:30 p.m. SCREENING AND BIOLOGICAL MONITORING AS USED BY THE INSURANCE INDUSTRY

William E. Guthier

Medical screening and biological monitoring have for a long and varied history been part of the insurance industry's services to its policyholders. The property casualty insurer has been a supplier to the policyholder for safety and health consultation through contractual obligations and desires to assist in the control of losses. With a long-vested interest in loss control, there is a "natural" movement toward the major categories of preplacement and periodic examinations, medical surveillance, and special examinations. We have worked since 1912 toward cost-effective occupational safety and health programs. The responsibility for providing a safe workplace is solely that of the employer, not the insurer. Many workers compensation casualty insurance carriers are prepared to assist management in understanding the requirements of the law, planning and undertaking the steps necessary to comply with the law, and locating knowledgeable physicians to conduct the health examinations. The types of services available are subjects for review by this audience. Managing health records in the employment setting has become a complex operational problem because of the amount and type of health information being collected. Administration of group health and accident insurance plans, treatment for the ill and injured employees, voluntary health screening and counseling programs, preplacement and periodic physical examinations, and results of medical tests for health hazard exposures all contribute to this huge pool of acquired and stored health information. We keynote in our recommendations that medical records developed and maintained through a company-sponsored employee health service should be reviewed to assure that only essential information on a worker's health is collected and to limit its use in excess of those with the need for it. Trends indicate that employees will be seeking to have access to their own health records. When this occurs, it is best that there are no surprises.

Wednesday

5:00 p.m. A PILOT STUDY TO DETECT EARLY PREGNANCY AND EARLY FETAL LOSS

Nancy J. Ellish, C. Jason, H.-C. Chen, D.T. Janerich

The New York State Department of Health, in conjunction with the National Institute of Child Health and Human Development and the Environmental Protection Agency, conducted a 6-month pilot study to investigate the feasibility of detecting early pregnancy in a population of healthy women. This pilot study is the first step in estimating the rate of early fetal loss in a healthy population. Female Department of Health employees or the wives of male employees

were recruited through paycheck flyers. Women who were 18 to 34 years of age and were having unprotected intercourse two to three times a week were eligible to participate. To ascertain early pregnancy, monthly 3-day morning urine specimens were collected during each woman's late luteal phase. A specific HCG-radioimmunoassay, using antibodies against the unique carboxyl-terminal portion of HCG B, was used to determine pregnancy as early as 9 days fetal developmental age. Self-administered questionnaires and monthly updates obtained information about the women's reproductive and medical histories, as well as lifestyle characteristics. In addition, a brief questionnaire was sent to each woman's gynecologist to verify her reproductive history. Of the 42 inquiries regarding the study, 30 women met the eligibility requirements. Twenty women participated in the pilot study, with an average age of 30 years. Eleven of the women had never been pregnant and 12 had been trying to conceive for 6 months or less. Six pregnancies have been reported on a clinical basis, one of which ended in a spontaneous abortion. Analysis of lab tests and questionnaire responses is underway to determine the rate of clinically undetected pregnancy and early fetal loss in this study population.

Wednesday

5:00 p.m. THE ECONOMICS OF NOTIFICATION AND MEDICAL SCREENING FOR HIGH RISK WORKERS

Ruth Ruttenberg, M. Powers

Measuring the economic impact of notification and medical screening programs for high risk workers has been virtually nonexistent. The application of measurements of the economic impact of traditional medical screening programs to those for high risk workers has severe limitations. Conventional cost-benefit analysis is not well-suited for analysis when social policy rather than economic profit is the key motivating factor for action. The easily quantitative data have tended to be only short-run direct costs. Measurements of benefits have been incomplete, as have indirect impacts. Impacts which defy a specific allocation of dollar value have been incorrectly left out of analysis. Measuring the economic impact of a notification and medical screening program for high risk workers should include a comprehensive view of costs and benefits. A framework for analysis is proposed defining four major clients: the business community, the worker and his/her family, the local and regional public sector, and the federal government. For each client the positive and negative, quantitative and non-quantitative, direct and indirect, short and long-run effects are probed. After measurements are made for each impact, a summary analysis can be made of the positive and negative impacts on each client--some to be additive in dollar terms and others to be expressed in more suitable units. The results of the analysis will be succinct and clear, giving more perspective to the

policymaker than could be achieved from a single dollar figure. An example discusses the effect of aspects of the notification and screening program, conducted by NIOSH and the Workers' Institute, for Augusta, Georgia, workers exposed to beta-naphthylamine on cost and benefits for the worker and his or her family, the public sector, and the business community.

Thursday

8:30 a.m. CHROMOSOMAL ALTERATIONS AS INDICATORS OF OCCUPATIONAL EXPOSURE

Anthony V. Carrano

Structural changes in chromosomes were one of the first recognized forms of genetic injury resulting from exposure to physical and chemical agents. They remain today relevant and quantitative measures of genotoxic exposure. Depending on the lesions induced in the DNA, and therefore, on the nature of the genotoxic substances, damage to chromosomes falls into two categories, structural aberrations and sister chromatid exchange (SCE). Structural aberrations are efficiently induced by those agents that directly break the DNA backbone, while SCEs are efficiently induced by those substances that form adducts to the DNA or otherwise distort the helix. Because these two endpoints respond differently to chromatin lesions, they are complementary in any study designed to identify potential exposure. The circulating lymphocyte in the human is an appropriate cell type in which to measure cytogenetic changes because it is readily accessible, carries genotoxic substances and their metabolites throughout the body, is long-lived, and can integrate exposure. In animal and human studies, it has been shown that both SCEs and aberrations can persist in the lymphocyte following acute or chronic exposure. A major objection to the use of lymphocyte cytogenetics in occupational studies is that chromosome damage in this cell type cannot be used as an indicator of an ill-health effect. While this is true, it can be argued that the presence of damage is an indicator of personal exposure and hence has a proper place in an industrial hygiene program. Moreover, many agents that induce chromosome damage are also carcinogens. (Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under contract number W-7405-ENG-48 and IAG NIOSHIA-81).

Thursday

8:30 a.m. MEDICAL SURVEILLANCE: ETHICAL, SOCIAL, AND BIOLOGICAL PERSPECTIVES

Sheldon W. Samuels

The need to extend medical surveillance, for which screening is one tool, to populations at high risk of occupationally attributable disease has no necessary "labor" perspective. Ethical, social, and biological perspectives supersede labor-management, economic, ideological, and political considerations. Ethical values are paramount and need to be understood in terms of their derivation and implications in the form of "rights" or criteria for moral judgment. Participatory decisionmaking is the essence of the social perspective and, while still evolving, is being shaped in the right-to-know and notification controversies. Discussion of the biological perspective heuristically is conducted in terms of "population thinking." However, critical methodological problems emanate from this approach that impact on the necessarily deterministic orientation in the interpretation of individual surveillance data. "As if" language reminiscent of modeling techniques finds expression in "presumptions" enabling the management of populations and individuals.

Thursday

9:00 a.m. OPTIMAL DESIGN AND COHORT SIZE REQUIREMENTS FOR HUMAN STUDIES OF INDUCED SPERM CONCENTRATION AND MORPHOLOGY EFFECTS

Andrew J. Wyrobek, D. Moore II, G. Watchmaker, L. Gordon

Decreased seminal sperm concentration and abnormal morphology are sensitive indicators of altered sperm production in animals and man. Sperm data from biomedical workers and unexposed cohorts of three occupational studies were used to assess within- and among-person variations and to calculate cohort size requirements for various study designs. Sperm concentration and morphology patterns were determined for 23 men who provided 225 semen samples, collected approximately monthly, and for 95 men who provided one semen sample each. Occupational, medical, and personal factors were also evaluated. For the 23 men we found a mean sperm concentration ($\pm$S.D.) of 103.2 $\pm$ 61.4 x 10^6 sperm/ml (coefficient of variation, CV = 59 percent) and proportion of non-oval forms of 45.1 $\pm$ 13.4 percent (CV = 30 percent). Similar values were obtained for the 95 men of the unexposed occupational cohorts: sperm concentration, 97.4 $\pm$ 94.0 x 10^6 sperm/ml and morphology 46.2 $\pm$ 13.7 percent. The average CV of repeated semen samples from the 23 men was considerably reduced for both parameters: sperm concentration (CV = 42 percent) and morphology (CV = 12 percent). Using a t-test applied to

normalized data, we calculated cohort size requirements for both endpoints for two study designs: (1) cross-sectional design, where sperm values from exposed and unexposed cohorts are compared, and (2) longitudinal design, where sperm samples collected from individuals before and after exposure are compared. For the cross-sectional design, sperm morphology requires approximately threefold fewer subjects than does sperm concentration to detect the same percent change in mean value. The actual cohort sizes depend on the magnitude of the expected change. In a longitudinal study design, cohort size requirements for morphology are reduced an additional 8- to 10-fold. These comparisons underscore the advantages of using longitudinal study designs for detecting induced changes in human sperm production. (Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under contract No. W-7405-ENG-48).

Thursday

9:00 a.m. LOSS CONTROL AND ITS PLACE IN THE INSURANCE INDUSTRY

Ambrose B. Kelly

The historical background of insurance company efforts to control industrial accidents and occupational disease will be discussed. The presentation will outline the development of insurance programs intended to reduce the frequency and severity of injuries, including a reference to pre-employment physical examinations and the degree to which they are recommended by insurers.

Thursday

9:30 a.m. POTENTIAL METHODS TO MONITOR WORKERS EXPOSED TO CARCINOGENS: BENZO(A)PYRENE-DNA ADDUCTS AS AN EXAMPLE

Frederica P. Perera, R. Santella, M. Poirier

More precise and sensitive methods are needed for early detection and assessment of human risk from occupational exposures to carcinogens. Human monitoring of biologically effective dose and preclinical response has the potential to flag the need for protective measures and/or surveillance. Comparable biologically effective dose and preclinical response data in humans and laboratory animals for whom tumor incidence is known can also enhance risk extrapolation between species. This paper will provide a brief overview of biomonitoring methods now under development, including advantages, limitations, application to date, and research needs. Data from human and animal pilot studies using an enzyme linked immunosorbent assay with antibodies to benzo-(a)pyrene-DNA will be presented as an illustration of these points. These data show the limit of detection to be about

one carcinogen residue per 10^7 nucleotides or 0.08 femtomole adduct per μg DNA. Adducts were detected in lung tissue of a number of lung cancer cases but not controls; placental tissue of smokers showed a significant increase in levels of adducts (P= .025) compared to nonsmokers. Although a number of problems remain to be solved, this method appears promising as a dosimeter. Application to the monitoring of worker populations will require further validation and careful thought about the use to which monitoring data will be put.

Thursday

9:30 a.m. SURVEILLANCE MONITORING AND REGULATORY CONCERNS

Ralph E. Yodaiken

Medical surveillance requirements are a mandated segment of regulated Health Standards. In addition guidelines provide the non-mandatory provisions and usually these appear in an appendix. Which provisions should be mandated and which should be suggested as guidelines is often a dilemma. Mandated requirements include routine medical examinations. Biological monitoring as a means of predicting health effects is also mandated in some cases (blood lead) but not in others. Monitoring is a team effort involving numerous disciplines, some overt, such as medical and industrial health, and some arcane, such as the legal and economic aspects. Thus provisions for medical monitoring may also be policy decisions. The ultimate decision for individual standards involves a broad spectrum of opinion extending beyond national borders to include international concepts.

Thursday

10:30 a.m. A VIEW FROM INSIDE A CITY BUREAUCRACY

John M. Myers

Within the past two years, a major metropolis undertook a review of its policies and practices with respect to pre-employment medical screening. What it found was a process rich in lore and tradition and based on decades-old assumptions unsupported by modern literature or medical thought. It was a system operating the way it always had simply because it had. Standards no longer seemed to meet the evolving requirements of Federal, state, and local legislation and there was an excruciatingly high level of internal resistance to any modification that could be perceived as a lowering of standards, even where existing standards were unsupported except by anecdotal "evidence." In the end, reason prevailed, to the chagrin of some. The lesson to be learned from the experience of this metropolis is that the advocates

of change must be prepared for major efforts within their own bureaucracy, in order to succeed. For reasons of doctor, lawyer, and metropolitan rights of privacy and confidentiality, the names will be changed to protect the innocent and the involved.

Thursday

10:30 a.m. SCREENING FOR CANCER: LESSONS LEARNED

Barbara S. Hulka

The purpose of this paper is to clarify (1) the objectives of screening programs, (2) characteristics of diseases suitable for screening, (3) features of suitable screening tests, (4) levels of program evaluation, and (5) the weighing of evidence on the advantages and disadvantages of screening. Objectives may be formulated at different levels--from the ability to sort people into groups, likely or unlikely to have a particular disease, to the reduction of disease-specific mortality. Tangential objectives related to increasing compliance with health-related behavior, enhancing opportunities for health counseling, or even providing a perceived health service or benefit are not irrelevant. Diseases suitable for screening are those leading to serious morbidity and high mortality, having a prolonged preclinical phase in their natural course, and for which effective therapy is available following early diagnosis. Useful screening procedures have documented validity, acceptability, and safety and are performed with relative ease and modest cost. Programs may be evaluated in operational terms of participant counts, diagnosed cases and dollars spent, or as a function of cancer control--reduced case fatality and cancer mortality. These generic issues in cancer screening will be exemplified in the context of screening for cervical, breast, colorectal, and lung cancer. Each of these cancers illustrates the weighing of different kinds of evidence when advocating or rejecting screening.

Thursday

11:00 a.m. THE USE OF RADIOGRAPHY FOR SCREENING EMPLOYEES AT RISK OF LOW BACK DISABILITY

Jack Edeiken, D. Karasick

Low back pain continues to be a major industrial health problem in terms of compensation costs and disability. The plant physician must utilize all possible clinical and diagnostic means to assist in the selection and maintenance of the employee. Pre-employment lumbar spine radiographic screening was first utilized on a large scale during the early post-World War II period. Since then there have been numerous publications for or against its use. A study

involving over 4,000 preplacement low back radiographic examinations demonstrated that approximately 28 percent of the individuals were unacceptable for production work, which included lifting. The study concluded that rejection or selective placement is justifiable based on follow-up studies on loss of time due to back injuries over a period of three years. In their opinion, strains superimposed on the normal bony structure are not as critical as the same stress applied to a back with a congenital or an acquired deficiency. Criteria suggested by other authors for absolute rejection from heavy work include previous surgery, spondylolysis, spondylolisthesis, and marked narrowing of the intervertebral disc space, particularly at the lumbosacral junction. Employee disability and compensation is a major business concern. The use of pre-employment lumbosacral screening has been beneficial for both the employer and the employee. Because current literature argues this point, the use of pre-employment low back X-rays should not be prohibited.

Thursday

11:00 a.m. SPUTUM CYTOLOGY

Myron R. Melamed

The role of sputum cytology as an adjunct to the chest X-ray in patients at risk of lung cancer will be discussed. In particular, the applications of this technique and its accuracy with respect to the various types of lung cancer will be reviewed, and data presented on the role of sputum cytology and the screening test for lung cancer.

Thursday

11:30 a.m. USE AND EFFECTIVENESS OF CHEST RADIOGRAPHY AND LOW BACK RADIOGRAPHY

Lireka P. Joseph, J.A. Rachlin

One facet of the Food and Drug Administration's educational programs to optimize the use of medical radiation involves investigations of the efficacy of selected X-ray examinations. The goal is to provide clinical information needed to aid physicians in their clinical decisionmaking. The routine chest X-ray screening examination has been studied and recommendations for five applications of chest X-ray screening have been published. These recommendations plus results of FDA research on the efficacy of low back radiography will be discussed.

Thursday

11:30 a.m. CYTOPATHOLOGY USE AND POTENTIAL IN MONITORING WORKPLACE ENVIRONMENTS BY SCREENING FOR BIOLOGICAL EFFECTS OF EXPOSURE

John K. Frost, W.C. Ball, Jr., M.L. Levin, M.S. Tockman, Y.S. Erozan, P.K. Gupta, N.J. Presaman

Internal epithelia exposed to the environment, such as those of the respiratory, urinary, and gastrointestinal tracts, are particularly susceptible and among the first to react to noxious agents. They are functionally differentiated to protect themselves in great measure; but through injury and chronic irritation, degrees of these protective mechanisms are lost. Many features of these reactions to the environment are detectable by carefully assessing morphologic changes in cellular material which is harmlessly exfoliated from the surface. This evaluation of the reaction of intact human tissues of individuals exposed to environmental situations by carefully analyzing their exfoliated cells is more direct in certain situations than in vitro exposure of microorganisms or tissue cultures. While less manipulable than in vitro studies, this human monitoring does allow for detection of changes from unexpected toxic effects as well as from improvement in the environment. Sputum cytology and X-ray screening for lung cancer in the Johns Hopkins University/NCI "Early" Lung Cancer Project since 1969, have brought more clearly into focus certain key areas where reaction of tissues (i.e., injury, repair, carcinogenesis) is reflected in cells exfoliated from the surface of the respiratory tract. Screening and surveillance of the respiratory epithelium in both Phase I and Phase II of this Project have included environmental situations involving cigarette smoke, asbestos, chemicals, and other toxic fumes. Evaluating the specificity and sensitivity of these techniques, which use intact human tissues, is of a long-term nature and under close scrutiny. Automated electronic systems under development offer great promise for providing, in addition to human evaluation, extremely sensitive and valuable information on tissue response to environmental toxic agents.

Thursday

1:30 p.m. PROBLEMS IN NOTIFICATION AND SCREENING OF WORKERS AT HIGH RISK OF DISEASE

Paul A. Schulte

Current and former workers who have been exposed to occupational carcinogens have unique medical and social problems and needs. To merely notify these workers of risks does not minimize their problems but rather initiates awareness of them. There are few societal programs that recognize the needs of these workers. Consequently, screening and

medical surveillance assume a pivotal role in a system that inadequately deals with the needs of workers identified and notified of occupational disease risks. In some cases screening programs using ineffective techniques are established because they represent surrogates for other kinds of support programs that do not exist in society today. Where screening techniques are effective and available, there still are problems in getting them funded and established in acceptable programs. To come to grips with this problem, the following are proposed: (1) The screening debate be recast to include not only survival as a criterion, but also how screening serves to affect the quality of life; (2) screening and surveillance be seen to include monitoring for disease markers and indicators of multistage transformations so that chemopreventive and behavioral modification efforts can be promoted and evaluated; (3) a systematic and comprehensive program to deal with the needs of "at risk" workers be considered.

Thursday

1:30 p.m. PULMONARY FUNCTION SCREENING IN OCCUPATIONAL HEALTH

John R. Goldsmith, S.M. Scharf

Although testing of lung function among occupationally exposed workers has demonstrated its usefulness in risk evaluation and in medical surveillance, there are two classes of problems which need clarification before they can be useful for screening among occupational groups in general or those exposed to inhalational risks. The primary requirement for any screening test is that "the natural history of the disease can be beneficially modified by therapeutic intervention or by removal of the risk factors at the stage of disease identified by screening." The recent American Thoracic Society Task Group was not able to recommend screening for chronic obstructive disease in the general population. Priority for screening of employed groups should be given therefore to risk factor reduction, including smoking cessation if it can be demonstrated to be effective. Such demonstrations need to be integrally related to proposed screening programs. The second group of problems relates to the screening procedures, equipment, and the interpretative principles. There are no agreed upon principles for determining what levels of which test results indicate need for further evaluation or risk reduction. For example, it is generally stated (conventional wisdom?) that expected values for lung function among black populations are 15 percent lower than for whites. There are many shades of skin color and no biological basis for thinking that skin color is a determinant of pulmonary function. There is confusion as to the magnitude and effect of age on "normal" lung function. There is confusion as to the number of tests of FEV to perform and which to choose to represent an individual's results. Choice of equipment and tests should depend on test specificity and sensitivity. We propose that principles for

deciding the objectives and limitations of lung function screening in occupational health can be derived from the ATS Report, taking appropriate account of the differences in occupational health practice and general health care, and giving priority to detecting and reducing the risk factors specifically associated with occupation and smoking. Anthropometric prediction factors should be tested as mechanisms for explaining the apparent ethnic gradients in lung function. Age may not be useful as a prediction factor in workers (and others) under 30 years of age. Standardized procedures for estimating and applying test specificity and sensitivity criteria are proposed. A Working Group agenda is proposed for an international effort to determine sound and effective principles for using lung function tests among occupational groups, bearing in mind the different uses of such tests for job placement, disability evaluation, clinical evaluation, research, as well as screening.

Thursday

2:00 p.m. AN IMPROVED NUCLEAR FLUORESCENCE SCREENING TECHNIQUE

George P. Hemstreet, III, S.S. West, R.P. Gillum, B.J. McClellan, N.A. Honker, R. Doggett

Three separate screening studies have tested the sensitivity and specificity of quantitative fluorescence image analysis for detecting bladder cancer. Nuclear intensity (NI) measurements of fluorescent dye-stained epithelial cells from voided urine and bladder washings were compared with conventional (PAP) cytology results, and findings were verified against pathological biopsy diagnoses. The NI cytology method detected the pathologically-confirmed tumors earlier and with greater specificity than did conventional cytology. In the study of 140 clinically-symptomatic patients in Oklahoma, the NI method detected 91.1 percent (31) of the 34 pathologically-confirmed Grades 1 and 2 tumors and 100 percent (18 of 18) of Grades 3 and 4 tumors. PAP cytology detected only 47 percent (16 of 34) of low and 78 percent (14 of 18) of high-grade tumors. Comparable results were achieved in the other two studies testing this method--a clinically-symptomatic cohort in Mississippi and a high-risk, occupationally-exposed cohort in Georgia. In the occupationally-exposed group, 345 persons were evaluated in "high-exposure" and "no-exposure" categories, with a positive correlation using NI and no correlation using PAP cytology. The relative risk for aneuploidy for high exposure was 3.83 for NI, 1.68 for PAP. The NI cytological method detects DNA aneuploidy (cancer) by quantitating the fluorescence emitted by the acridine orange (AO)-stained cell nucleus. AO dye binds stoichiometrically to the nuclear nucleic acid. The emitted fluorescence is measured in standard phosphor particle units (ppu). Cells with greater than normal (.5) ppu are then evaluated visually. The speed and cost-effectiveness of the NI method are enhanced through use of a computer-directed microscope that automatically scans large numbers of

cells on a slide and selects the cells with non-normal ppu measurements for visual evaluation. We hypothesize that positive NI may precede visible morphological changes by 5 to 10 years, suggesting that use of NI cytology could significantly improve predictive capability.

Thursday

2:00 p.m. APPROACHES TO ASSESSING PULMONARY DYSFUNCTION AND SUSCEPTIBILITY IN WORKERS

Kathleen Kreiss

Indices of the maximal forced expiration are the most widely adopted method of screening for occupational lung disease because of their ease of measurement, employee acceptability, and reproducibility. However, these indices may lack sensitivity, specificity, or validity in detecting cases of some occupational lung diseases at asymptomatic stages when intervention may affect outcome. In populations at increased risk for occupational asthma, three other methods of screening are being evaluated in field settings: tests for bronchial hyperreactivity such as isocapnic hyperventilation (usually with cold air) and nonspecific agonist challenge (usually methacholine) and logs kept by employees of peak flow measurements. In working populations at increased risk for restrictive lung disease, such as pneumoconioses and hypersensitivity pneumonitis, lung diffusing capacity measured by a single breath technique may be a more specific screening method and is adaptable to a field setting. Lung volumes obtained in a body plethysmograph are inappropriate for screening in nonresearch applications because of the complexity of equipment. Abnormalities in gas distribution can be detected at an early and probably reversible stage by the single breath nitrogen test, also feasible in field settings. However, whether detected abnormalities predict outcomes for which interventions are available has not been evaluated. These potential methods of screening--cold air challenge, methacholine challenge, peak flow logs, diffusing capacity, and single breath nitrogen test--await "clinical trials" in industrial settings to evaluate whether early case finding of susceptible subjects results in prevention of morbidity.

Thursday

2:30 p.m. STUDY OF THE DUPONT CHAMBERS WORKS PLANT BLADDER CANCER SCREENING PROGRAM

Thomas J. Mason, P.C. Prorok, W.E. Neeld, Jr., W.J. Vogler

Data have been abstracted on all persons ever screened for bladder cancer, as well as all persons known to have developed bladder cancer among the Chambers Works employees, regardless of whether they had been screened. Complete work histories were abstracted and included dates of employment by job title and location for the duration of employment by DuPont. Medical histories have been abstracted for both cases and non-cases and include the dates and results of every urinary cytologic reading; the dates and results of every urinary blood test; and the dates and type of every physical exam which the persons had been given, as well as vital status information, which will include data from death certificates. For each bladder cancer case, detailed clinical histories were abstracted to provide information concerning signs or symptoms of bladder cancer, procedures performed, findings of these procedures, and any recommendations made. Detailed pathologic information has also been abstracted to include type, grade, stage, evidence of multicentricity, metastatic sites, and also any second primary sites of malignancy. Data are presently being edited and subjected to very preliminary analysis.

Thursday

2:30 p.m. ONE-TIME SCREENING TO DEFINE A PROBLEM: LEGIONELLA EXPOSURE IN AN ELECTRIC POWER COMPANY

David C. Deubner, D. Owen, J.N. MacCormack, K. Kleeman

Screening of industrial employees is usually considered an ongoing, repetitious process, with emphasis on results on individual employees. One-time screening with emphasis on group results may be a more appropriate strategy, particularly when the nature and extent of the industrial problem are not well-defined. With this strategy in mind, an electric utility screened 1,455 production employees for job exposure to Legionella pneumophila sources, illness history, and antibodies to L. pneumophila serotypes I-IV. The screening was undertaken because L. pneumophila-associated illness outbreaks had occurred in a neighboring electric utility district, bacteria sero-compatible with L. pneumophila had been detected in all four plants participating in an environmental survey, and the company was concerned about the implications of these findings for their employees and the public living near power plants with large cooling towers. The survey revealed a prevalence of antibodies in employees consistent with general population surveys. Within the employee group, antibody titer was not associated

with either reports of recent illness or work exposure to potential L. pneumophila sources. Inability to detect a relationship between exposure to potential L. pneumophila sources and specific antibody results was used to define L. pneumophila as a historic non-problem for this company and to rationally advise against the need for an ongoing screening program. Publicity surrounding the one-time screening and the results has informed employees and management of the issue, positioning the company in a state of alertness to detect a change in clinical experience in the future.

Thursday

3:00 p.m. AN ALTERNATIVE WAY OF DETECTING CUMULATIVE TRAUMA DISORDERS OF THE UPPER EXTREMITIES IN THE WORKPLACE

Lawrence J. Fine, B.A. Silverstein, T.J. Armstrong

This study was conducted in an aircraft engine assembly plant. Workers were randomly selected from eight jobs. These jobs were selected in such a manner that it was expected that they would cause different frequencies of cumulative trauma disorders of the upper extremities. A total of 159 workers were examined with a standardized questionnaire and physical examination to determine the frequency of current and past cumulative trauma disorders of the upper extremity. In addition, the medical records of these individuals were separately reviewed to determine the frequency of these disorders as diagnosed by the plant medical personnel. For those diagnoses that could reasonably be expected to be contained in the company medical records or that should have been present during the time of our survey, we determined whether they had been correctly identified by our standardized questionnaire and physical examination. The sensitivity of the standardized examination was 95.7 percent and the specificity was 44.4 percent. The large number of "false positives" is not surprising. We will discuss in detail the probable reasons for this large number of false positives. The results of these analyses indicate that the standardized examination and questionnaire are effective in detecting cumulative trauma disorders of the upper extremity. The current version of the standardized survey requires about 30 to 40 minutes per individual. The length of the survey can be substantially reduced without a loss of valuable information.

Thursday

3:30 p.m. USES OF BIOLOGICAL MONITORING AND SCREENING DATA AS EVIDENCE IN LEGAL PROCEEDINGS

Michael S. Baram

The uses of biological monitoring and screening data in legal proceedings to compensate workers for occupational diseases will be explored. The two major compensatory mechanisms of our legal system--workers' compensation and tort liability--will be separately discussed. After tracing the evolution of workers' compensation coverage for occupational disease, the following issues will be presented: (1) the application of rules of evidence to biological monitoring and screening results; (2) the use of such data in proving diagnosis, prognosis and causation, and for meeting the statutory time limitations of an occupational disease claim; and (3) defensive use of such evidence by an insurer/employer to refute a worker's claim for compensation. Tort liability for occupational disease will also be examined, in terms of the uses of biological monitoring and screening results by a worker to prove the existence of hazard, the proximate cause of illness, and the employer's knowledge of a workplace risk. Such data may be used defensively by an employer to prove contributory negligence, assumption of risk, and employer compliance with the state-of-the-art, etc. In conclusion, the long- and short-term effects of the availability of biological monitoring and screening data on employer liability and employee health will be presented.

Thursday

4:00 p.m. DISCRIMINATORY ASPECTS OF SCREENING

Mark A. Rothstein

Medical screening of workers may be based on a wide range of medical and epidemiologic considerations, such as prior illnesses, prior occupational exposures, genetic factors, musculoskeletal configuration, and smoking and drinking habits. Although several screening techniques have been questioned in the scientific literature, there are presently few legal restrictions on the use of medical screening of workers. The Occupational Safety and Health Act (OSHA) requires that certain medical tests be performed when workers will be exposed to specific toxic substances. Nevertheless, OSHA does not prohibit the use of any medical screening measures nor does it indicate what actions an employer may or may not take as a result of such information. (A notable exception is the medical removal provision of the lead standard.) If the screening procedures adversely affect individuals on the basis of race, color, religion, sex, national origin, or age, there may be some protection afforded under Title VII of the Civil Rights Act of 1964 and the Age Discrimination in Employment Act. Another relevant

statute is the Rehabilitation Act of 1973, which prohibits Federal contractors and recipients of Federal financial assistance from discrimination in employment against otherwise qualified handicapped individuals. It is not clear, however, whether a believed predisposition to occupational illness constitutes a handicap. Thus, the law has, in general, failed to take into account the discriminatory aspects of medical screening.

Thursday

4:00 p.m. ANALYTICAL METHODS FOR ASSESSING EXPOSURE TO 4-AMINOBIPHENYL BASED ON PROTEIN ADDUCT FORMATION

Paul L. Skipper, M.S. Bryant, S.R. Tannenbaum, J.D. Groopman

Past studies with experimental animals have demonstrated that 4-aminobiphenyl (ABP) administration results in the formation of appreciable amounts of adducts between the carcinogen and both serum albumin and hemoglobin. The hemoglobin adduct is relatively stable in vivo, but may be readily hydrolyzed in vitro to regenerate ABP. The formation of this adduct reflects a mixed-function oxidase-mediated metabolic pathway operating directly on the amine. The predominant albumin adduct, 3-(tryptophan-N1-yl)-4-acetylaminobiphenyl, reflects the contribution of N-acetyltransferase activity as well as MFO activity to the overall metabolism. The simultaneous measurement of these two different adducts thus offers an opportunity to investigate the role of both ABP and acetylator phenotype in bladder carcinogenesis. An analytical method was developed for the quantitation of ABP adducted to hemoglobin which uses gas chromatography coupled with electron capture detection. The method is capable of detecting less than 100 pg adduct in 10 ml of blood. A monoclonal antibody has been produced to facilitate the quantitation of ABP-serum albumin adducts. It recognizes both ABP bound to serum albumin via an azo linkage and 4-acetylaminobiphenyl. Rats receiving conventional animal care and never deliberately exposed to ABP were found to consistently display a hemoglobin adduct level of 400 to 1800 pg adduct per 10 ml of blood. Several human subjects exhibited a much lower (<200 pg/10 ml) level.

Thursday

4:30 p.m. OSHA AUTHORITY FOR BIOLOGICAL MONITORING AND MEDICAL SCREENING

Benjamin W. Mintz

The Occupational Safety and Health Act of 1970, whose broad purpose is to "assure so far as possible...safe and healthful working conditions" for American workers, authorizes the Secretary of Labor to issue occupational safety and health standards. Section 6 (b)(7) of the Act requires that occupational health standards "prescribe the type and frequency of medical examinations or other tests which shall be made available, by the employer or at his cost, to employees exposed to...hazards in order to most effectively determine whether the health of such employees is adversely affected by such exposure." OSHA has issued (after rulemaking) health standards covering about 24 toxic substances and all these standards have included medical surveillance programs. OSHA thus is not only empowered but is compelled by law to require medical surveillance programs for exposed employees. At the same time, there have been a number of major legal/policy issues relating to medical surveillance that have been raised at the standards rulemaking stage and litigated in court. Among the more significant of these are: (1) Access to medical records: Should employees have access to their own medical records? Should labor organizations representing employees for collective bargaining purposes have access? Should any restrictions be placed on OSHA's access to individual medical records? What about trade secret protection? (2) Selection of physician: Should the employer or the employee select the physician to conduct the medical surveillance examination? Is a "three-physician" review procedure within OSHA's authority and should it be implemented? (3) Medical removals: Should OSHA standards require removal of employees who are at excess risk from dangerous exposures? Does OSHA have authority to limit an employer's right to take personnel actions based on the results of medical examinations? Should employers removing employees because of excess risk be required to protect employee wages and seniority rights for a period of time? Many of these issues were involved in OSHA's lead standard, issued in 1978, and affirmed in relevant part by the Court of Appeals for the District of Columbia in 1980; and the "medical access" rule issued in 1980 and recently upheld by the Court of Appeals for the Fifth Circuit. These two proceedings will be used as a focus for the discussions of medical surveillance programs under the OSHA Act.

Thursday

4:30 p.m. DETECTION OF OCCUPATIONAL EXPOSURES BY BACTERIAL MUTAGENESIS ASSAYS OF HUMAN BODY FLUIDS

Richard B. Everson

Mutagenesis assays of human body fluids provide a means to document human exposure to mutagens in the workplace. Results of these assays not only indicate the presence of mutagens, but demonstrate their absorption and distribution to tissues. Assays are typically conducted by extracting specimens of urine with XAD-2 resin and/or further liquid partition extraction. In most studies these extracts were analyzed for mutagenicity using the Salmonella/mammalian microsomal plate assay. Less frequently used analytic techniques include conducting bacterial mutagenesis assays with modified liquid incubation procedures or fluctuation tests instead of the plate assay, and testing the ability of extracts to induce sister chromatid exchanges in cultures of mammalian cells. Studies using these methods have reported increased mutagenicity in body fluids of individuals exposed to lifestyle and dietary factors, including smoking and ingestion of cured meat products; medications including niridazole, metronidazole, nitrofurantoin, and several agents used for cancer chemotherapy; and occupational exposures to drugs used for cancer chemotherapy, epichlorohydrin, rubber manufacturing, carbon electrode manufacturing, and other chemical manufacturing. In other studies mutagenicity was not observed in urine samples from other groups of individuals occupationally exposed to drugs used for cancer chemotherapy, coke oven workers, coffee drinkers, or hair dye users. The advantages, disadvantages, and potential role of this approach will be briefly discussed and compared with other approaches to the identification of mutagenic hazards in the workplace.

Thursday

5:00 p.m. BIOLOGICAL MONITORING AND OCCUPATIONAL DISEASE LIABILITY

Lisa J. Raines

The impact of biological monitoring on occupational disease liability will be discussed. The limitations of workers' compensation statutes will be addressed and the various theories of employer liability (negligence, strict liability, and product liability) will be described. Emphasis will be placed on the employer's liability for reproductive damage caused by workplace exposures. After a description of the general principles governing liability, the following issues will be discussed: circumstances under which the law places a duty on employers to biologically monitor certain of their employees for hazardous occupational exposures; the liability that may result when employers fail to biologically monitor their employees; imposition of

personal liability on the company physician; liability to the spouse and offspring (both liveborn and stillborn) of a reproductively damaged worker; liability for birth defects caused by exposure prior to conception; and the role of an employee's own negligence in claims of employer liability for occupational diseases.

Thursday

5:00 p.m. GEOGRAPHICAL DISTRIBUTION OF UNEXPLAINED LOW BIRTH WEIGHT

Casey Jason, B.S. Glick, S.M. Welsh

Low birth weight, largely in the form of intrauterine growth retardation, has been used in animal studies as a sensitive indicator of adverse reproductive outcomes to a suspect toxic agent. Methodologic problems have severely curtailed studies of low birth weight for human risk assessment. Here we explored the use of statistical techniques to adjust for maternal risk factors and to isolate U.S. counties for blacks and whites that have a significantly elevated rate of unexplained low birth weight in 1979. This information is derived from individual birth certificate information made available by the National Center for Health Statistics. After standardizing variation due to population-at-risk size, and then removing variation due to socioeconomic and other intrinsic factors available on birth certificates, clusters of high-risk counties appear. This paper discusses the methodology used to identify these counties.

Friday

8:30 a.m. SCREENING WORKERS EXPOSED TO SUSPECT BLADDER CARCINOGENS

Raymond A. Cartwright

Workers last exposed to dye intermediates over 25 years ago still have substantially increased risks of bladder cancer. The experience of detecting such cases through screening programs in one part of the North of England is currently being used as a model for more general application to other industrial situations where there may be increased bladder cancer risks. From work in parts of the North of England, it has become apparent that (1) malignant cell cytology screening is highly subjective; (2) attention to the results of screening indicates that early treatment ought also to be considered as part of the "screen"; (3) the early natural history of the disease is of some importance in conceptualizing the problems and results of screening; and (4) the epidemiology of high risk groups might prove invaluable in extending screening to other groups, in particular their genetic susceptibility. In an effort to address these points, an observational study has been set up in

Huddersfield. The long-term aim is to set up a trial of very early disease contrasting therapy for early lesions with the long-term aim of altering the occurrence of invasive bladder lesions in the group of interest.

Friday

9:00 a.m. LUNG CANCER SCREENING

Robert S. Fontana

Since 1971 the National Cancer Institute of the United States has sponsored three randomized controlled trials of screening for early lung cancer in large, "high-risk" populations (men, 45 years of age or older, who have been heavy cigarette smokers). The major aims of these trials have been to determine (1) whether lung cancer detection can be improved by adding 4-monthly sputum cytologic screening to either yearly or 4-monthly chest roentgenography, and (2) whether lung cancer mortality can be significantly reduced by this type of screening program, followed by appropriate treatment. When the trials began, it was assumed that annual chest roentgenography did not affect lung cancer mortality; however, this notion has never been adequately evaluated. At present, results of the three screening programs suggest (1) sputum cytology alone detects 15 to 25 percent of lung cancers, almost all of which are squamous cancers with a favorable prognosis; (2) chest roentgenography may be a more effective test for early-stage lung cancer than previous reports have suggested; (3) considerably more early-stage, resectable lung cancers have been detected in the screened groups than in the control populations; (4) survival has been better in the screened groups than in the controls; (5) there has been no substantial difference in lung cancer mortality in the screened and the control groups. These observations will be elaborated and confounding features will be discussed.

Friday

9:30 a.m. USE OF DATA FROM THE X-RAY SURVEILLANCE OF COAL MINERS TO EVALUATE THE EFFICACY OF THE DUST STANDARD

Rochelle Althouse, M. Attfield, S. Kellie

NIOSH administers the X-Ray Surveillance Program for underground coal miners, a program mandated by the Federal Health and Safety Act of 1969. The surveillance file, which contains over 200,000 chest X-rays, affords an excellent source for study of prevalence, incidence, and progression of Coal Workers Pneumoconiosis (CWP). Two epidemiologic analyses have recently been completed using these data. One, a prevalence study of miners with 10 years or less of mining tenure converted the more liberal readings of the

surveillance program to median epidemiologic readings. Initial and converted prevalences were .59 percent and .44 percent for the 0 year tenure group; 1.09 percent and .79 percent for the 1 to 9 year tenure group. A second analysis re-read X-rays of a subgroup of 1,834 repeat miners with little or no exposure at their first examination. Results indicated net progression from category 0/0 of 1.2 percent. Although both findings indicate that changes in radiographic evidence of CWP are consistent with those expected under the mandated dust levels, caution must be used in their interpretation. Issues for consideration in our use of the surveillance data for research analyses are selection bias, differences in X-ray interpretation, and miner participation. The latter showed a decline from 45 to 52 percent at round one, to 33 to 42 percent at round three. Recommendations for improving participation are discussed.

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